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58 William St., New York.

VOLUME XVIII. DECEMBER, 1901.

PROCEEDINGS

OF THE

American Gas Light Association.

TWENTY-NINTH ANNUAL MEETING

HELD AT

BOSTON, MASS., OCTOBER 16–18, 1901.

PUBLISHED BY THE ASSOCIATION.

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CONTENTS.

PAGE.

Twenty-ninth Annual Meeting—Roll Call ... 1

Names Proposed for Membership (and Elected) ... 7

Report of Council ... 12

Election of Dr. H. Bunte and Herr W. von Oechelhaeuser to Honorary Membership ... 14

Report of Treasurer and Finance Committee ... 14

“ Secretary ... 16

“ Trustees Gas Educational Fund ... 18

“ “ “ “ Appendix to ... 24

President's Address ... 170

“ “ Appointment of Committee on ... 188

“ “ Report of Committee on ... 258

Report of Committee on Nomination of Officers ... 188

Election of Officers ... 189

President Elect, Acknowledgment of his Election by ... 189

Officers “ “ “ ... 189

Report of Progress by Committee on Uniform Accounts, followed by discussion ... 190

Sergeant-at-Arms, Announcement by President of Appointment of ... 201

Expressions of Regret at Inability to Attend Meeting ... 202, 238

Report of Research Committee ... 202

Place of Next Meeting, Appointment of Committee on ... 203

“ “ Report “ “ ... 257

Discussion of Mr. Frank D. Moses' Paper on “What is the Business of a Gas Company?” (For the Paper see Appendix, page lxx) 203

Report of Committee on National Gas Advertising, followed by discussion ... 220

Discussion of Mr. Wm. E. McKay's Paper on “Tar and Water from Water Gas.” (For the Paper see Appendix, page xxi.) 225

Question Box Opened ... 234, 265, 267, 310

Invitation from the New England Gas and Coke Company to the Association to Visit their Works at Everett ... 238

Committee to Award the Beal Medal for 1901, Appointment of ... 238

Committee on Final Resolutions, Appointment of ... 238

“ “ Report of ... 312

74643

D

PAGE.
Discussion of Mr. E. H. Earnshaw's Paper on "Further Notes on Retort House Practice." (For the Paper see Appendix, page i.) . 238
"Bagging Live Gas Mains," (followed by discussion.) A "Short Topic," by Mr. P. H. Gibbons 259
Discussion of Mr. T. Littlehales' Paper on "Retort Ovens as Producers of Illuminating Gas." (For the Paper see Appendix, page xlvii.) 270
Discussion on Mr. Chas. F. Prichard's Paper on "The Fuel Value of Residuals." (For the Paper see Appendix, page lxxvii.) 286
"A Comparison of Standards for Cast Iron Pipe and Specials," (followed by discussion.) A "Short Topic," by Mr. Walton Forstall.... 288
Adjournment 313

APPENDIX.

PAGE.
Further Notes on Retort House Practice, E. H. Earnshaw.......... i
Tar and Water from Water-Gas, Wm. E. McKay xxi
Retort Ovens as Producers of Illuminating Gas, T. Littlehales...... xlvii
What is the Business of a Gas Company? Frank D. Moses.......... lxx
Fuel Value of Residuals, Charles F. Prichard...................... lxxvii
In Memoriam xciii
" William G. Abel............................ xcvii
" Alfred C. Gandey.............................. xcviii
" Harold Humphreys............................. xcix
" David W. Crafts c
" Charles C. Fry ci
" William Stacey.................. cii
" James Slade...... ciii
" George B. Neal..... civ
" Wm. E. Barrows cv
" Wm. Wallace Goodwin...................... cvii
United States Patents Relating to Gas :
Issued October 1st, 1900, to October 1st, 1901. cxi
Expired October 1st, 1900, to October 1st, 1901 cxlvi
Current Gas Literature:
Publications Referred to clviii
Organization. clviii
Finance clxi
Process clxii
Plant clxiv
Material clxvii
Manufacture.. ... clxvii
Storage clxix
Distribution............................... clxix
Lighting................................... clxxii
Heating clxxv

E

PAGE

Current Gas Literature (*continued*):
- Power clxxv
- Residuals clxxvi
- Chemical clxxvii
- Physical. clxxviii
- Photometry clxxviii
- Management clxxix
- Electrical clxxxi
- Acetylene. clxxxii
- Miscellaneous clxxxii

New Publications clxxxv
List of Officers for 1901-1902. clxxxvii
" Members, Alphabetical, Honorary clxxxix
" " " Active cxc
" " " Associate ccxxx
" " Geographical ccxxxviii
" Deceased cclvii

LIST OF ILLUSTRATIONS.

Body of Volume and Appendix.

Frontispiece, Edward G. Pratt .... opp. page 1
Elevation and Plan of English and Flemish Bond .... " 29
Condensers .... " 44
Bell, Spigot and Lead Joint...................... .... " 52
Vertical Cross Section of Regenerative Setting of Six Retorts..... .... " 66
Vertical Longitudinal Section of Regenerative Setting of Six Retorts. .... " 67
Horizontal Section of Regenerative Setting of Six Retorts " 68
Sketches Showing Variation in Seal of Hydraulic Main Fitted with a Single Overflow . ... " 74
Feed Water and Blow-off Connections for Horizontal Tubular Boilers.................................. " 107
Hydraulic Main. .... " 118
Cross Section of Clay Retort .... " 133
6-inch Line Drip ... . " 143
Mouthpiece with Self-sealing Lid...................... " 152
Lowe Jet Photometer................................. " 161
Four-inch Tees with Bells and Flanges.... .... " 164
Bag Fork .... " 261
Bag Shield .... " 263
Comparison of American Gas Light Association and The United Gas Improvement Company, Bell and Spigot Standards.............................. .... 290 to 302

APPENDIX.

PAGE.
Standpipe Cleaning Tools xiii
Sections of Retort Oven... xlix
Sections of Boiler Furnace for Burning Coke lxxxi
Section of Underfeed Stoker used in Burning Coal and Coke Breeze..................... lxxxvi
Tar Burner and Position Occupied in Boiler Furnace............... lxxxviii

LIST OF SUBJECTS DISCUSSED,

WITH NAMES OF SPEAKERS.

SUBJECT.	SPEAKER.	PAGE.
Election of Members	Edward G. Pratt	12
	Wm. Henry White	12
Council, Report of (*For Report see p.* 12.)	Wm. Henry White	14
Election of Honorary Members	F. H. Shelton	14
Treasurer and Finance Committee, Report of (*For Report see p.* 14.)	Wm. Henry White	14
Secretary, Report of. (*For Report see p.* 16.)	Wm. Henry White	14
Trustees Gas Educational Fund, Report of (*For Report see p.* 18.)	E. H. Jenkins	169
	Edward G. Pratt	169
	Alfred E. Forstall	169
President's Address	Edward G. Pratt	170
" " Appointment of Committee on	Wm. R. Beal	188
	Wm. Henry White	188
Nominations, Report of Committee on	Wm. Henry White	189
	Edward G. Pratt	189
President Elect, Acknowledgment of his Election by	Wm. R. Beal	189
Officers Elect, Acknowledgment of Election by	A. S. Miller	189
	Rollin Norris	190
	E. G. Cowdery	190
Uniform Accounts, Report of Progress by Committee on (*For Report see p.* 190.)	A. C. Humphreys	190, 200
	Edward G. Pratt	198
	F. H. Shelton	198
	Alfred E. Forstall	199
	C. H. Nettleton	199
	E. E. Witherby	200
	F. Egner	201
Sergeant-at-Arms, Announcement by President of Appointment of	Edward G. Pratt	201
Research Committee, Report of. (*For Report see p.* 202.)	Edward G. Pratt	203
	C. H. Nettleton	203

SUBJECT.	SPEAKER.	PAGE.
What is the Business of a Gas Company?	Edward G. Pratt	203, 205, 211, 218
(*See Appendix, p.* lxx.)	G. W. Clabaugh	204, 215, 218
	L. D. Spragle	205
	F. Egner	206, 216
	W. S. Allen	207, 209
	Walton Forstall	208
	H. L. Rice,	209, 217
	C. D. Robison	210
	R. M. Searle	210, 211, 214
	T. Littlehales	211
	F. R. Persons	212
	H. H. Ganser	212
	A. S. Miller	214
	E. E. Witherby	215
	J. T. Lynn	216
	G. H. Harper	218
	F. H. Shelton	218
	F. D. Moses	219
National Gas Advertising, Report of Committee on	F. D. Moses	220, 223
	F. R. Persons	221, 223
(*For Report see p.* 220.)	Wm. Henry White	222, 224
	T. Littlehales	222
	F. H. Shelton	222
Tar and Water from Water-Gas	Edward G. Pratt	225, 226, 230, 233
(*See Appendix, p.* xxi.)	Wm. E. McKay	225, 230, 233
	A. S. Miller	226
	W. C. Morris	226
	Rollin Norris	228, 229
	F. Egner	229, 233
	Thos. Curley	229
	J. B. Klumpp	229
	A. E. Forstall	230
	Carroll Miller	230
	E. H. Jenkins	234
What Records have we of Gas Holders having been Struck by Lightning and What has been the Result?	Edward G. Pratt	234
	C. D. Robison	234
	E. J. Donahue	234
	A. E. Forstall	234, 235, 236, 237
	Robt. B. Taber (written)	235
	C. H. Nettleton	235
	S. J. Fowler	236
	John Williamson	236
	A. S. Miller	236
Further Notes on Retort House Practice,	Edward G. Pratt	238, 240, 243, 253
(*See Appendix, p.* i.)	W. A. Miller	239

SUBJECT.	SPEAKER.	PAGE.
Further Notes on Retort House Practice, (*Concluded.*)	M. S. Greenough	240, 244, 254
	Wm. R. Beal.	241
	Carroll Miller	242
	D. R. Russell	243
	N. W. Gifford	243
	F. Egner	243, 249
	A. E. Forstall	245, 249, 257
	R. M. Searle	249
	F. B. Wheeler	249
	Wm. H. White	250
	E. H. Earnshaw	253, 254, 255
	J. P. Harbison	255
	E. H. Jenkins	257
	W. R. Addicks	257
Place of Holding Next Meeting, Report of Committee on..	E. H. Jenkins	257
	Wm. H. White	257
	Wm. R. Beal.	257
	W. R. Addicks	258
	Edward G. Pratt	258
Committee on President's Address, Report of	Wm. H. White	258
	J. P. Harbison	259
Bagging Live Gas Mains	P. H. Gibbons	259
	Walton Forstall	259, 263, 264
	W. R. Addicks	263, 264
	T. Littlehales	265
"Do Many Gas Companies Carry Liability or Accident Insurance, and is such Insurance Necessary or Desirable for Gas Companies?"	H. A. Allyn	265, 266
	W. G. Africa	266
	N. W. Gifford	266, 267
"Is it Safe to Use Incandescent Electric Lights in a Purifying House, the Switch-board being Outside of the Building, and the Wiring in Iron Pipes?"	E. E. Witherby	267, 268
	C. W. Hinman	268
	E. J. Donahue	268, 269
	Edward G Pratt.	268
	L. D. Spragle	268
	C. A. Learned	269

SUBJECT.	SPEAKER.	PAGE.
"How Long is it Economical to Run a Lowe Water-Gas Apparatus without Cleaning the Checkerbrick? Is it Economical to Let Down the Machines for Twenty-four Hours Every Week in Order to Burn Out the Carbon which has Accumulated on the Checkerbrick?"	Rollin Norris	269
	J. E. Nute	270
	H. K. Morrison	270
Retort Ovens as Producers of Illuminating Gas	Edward G. Pratt	270
(*See Appendix, p.* xlvii.)	C. G. Atwater	270
	F. Egner	272, 285
	A. S. Miller	273, 277
	W. R. Addicks	274, 285
	C. H. Nettleton	276
	W. W. Seymour	277
	M. S. Greenough	277, 278
	T. Littlehales	278, 279, 285
	R. M. Searle	279
	F. H. Shelton	284
The Fuel Value of Residuals	Edward G. Pratt	286, 287
(*See Appendix, p.* lxxvii.)	F. C. Sherman	286
	C. H. Nettleton	286, 288
	Rollin Norris	286
	E. J. Donahue	286, 287
	A. S. Miller	287
	F. Egner	287
	W. C. Morris	287
	R. E. Holmes	287
	C. F. Prichard	287
A Comparison of Standards for Cast Iron Pipe and Specials	Walton Forstall	288, 309
	Edward G. Pratt	308, 309, 310
	A. S. Miller	308
	A. E. Forstall	310
	W. C. Morris	310
"Is the Method of Supporting Mantles in the Centre Superior to the Old Side-Rod Support?"	A. E. Forstall	311
	E. G. Pratt	311
	R. M. Searle	311

SUBJECT.	SPEAKER.	PAGE.
"To What Temperature is it Economical to Heat Oils before they are Sprayed on the Checkerbrick? What are the Most Economical Means of Obtaining this Temperature?"	A. E. Forstall	311
	E. G. Pratt	311
	E. J. Donahue	311
"What is to be Done with the Small Consumer, or rather the Would-be Small Consumer, who Wants to Use One Light or One 1-Burner Hot Plate?"	R. M. Searle	311, 312
	A. E. Forstall	311
"Have Any Gas Companies Sent Out their Bills in Postal Card Form, Printed on the Back thereof, and if so, Does the Plan Work Satisfactorily? Does the Cheapening of Distributing the Bills and Facilitating the Office Work Offset the Objection of Undue Publicity of a Consumer's Account that such Form of Bill Involves?"	F. N. Morton	312
	J. D. McIlhenny	312
	G. W. Clabaugh	312
	E. G. Pratt	312
Final Resolutions, Report of Committee on	Jas. Ferrier	312
	Walton Forstall	313

LIST OF SPEAKERS,

WITH SUBJECTS DISCUSSED.

SPEAKER.	SUBJECT.	PAGE.
ADDICKS, W. R.	Further Notes on Retort House Practice	257
	Place of Holding Next Meeting, Report of Committee on	258
	Bagging Live Gas Mains	263, 264
	Retort Ovens as Producers of Illuminating Gas	274, 285
AFRICA, W. G.	Do many Gas Companies Carry Liability or Accident Insurance, and is such Insurance Necessary or Desirable for Gas Companies?	266
ALLEN, W. S.	What is the Business of a Gas Company?	207, 209
ALLYN, H. A.	Do many Gas Companies Carry Liability or Accident Insurance, and is such Insurance Necessary or Desirable for Gas Companies?	265, 266
ATWATER, C. G.	Retort Ovens as Producers of Illuminating Gas	270
BEAL, WM. R.	President's Address, Appointment of Committee on	188
	President Elect, Acknowledgment of his Election by	189
	Further Notes on Retort House Practice	241
	Place of Holding Next Meeting, Report of Committee on	257
CLABAUGH, G. W	What is the Business of a Gas Company?	204, 215, 218
	Have any Gas Companies Sent Out their Bills in Postal Card Form, Printed on the Back thereof, and if so, Does the Plan Work Satisfactorily? Does the Cheapening of Distributing the Bills and Facilitating the Office Work Offset the Objection of Undue Publicity of a Consumer's Account that such Form of Bill Involves?	312
COWDERY, E. G	Officers Elect, Acknowledgment of Election by	190

SPEAKER.	SUBJECT.	PAGE.
CURLEY, THOS	Tar and Water from Water-Gas	229
DONAHUE, E. J.	What Records have we of Gas Holders having been Struck by Lightning, and What has been the Result?	234
	Is it Safe to Use Incandescent Electric Lights in a Purifying House, the Switchboard being outside of the Building, and the Wiring in Iron Pipes?	268, 269
	The Fuel Value of Residuals	286, 287
	To What Temperature is it Economical to Heat Oils before they are Sprayed on the Checkerbrick? What are the most Economical Means of Obtaining this Temperature?	311
EARNSHAW, E. H.	Further Notes on Retort House Practice	253, 254, 255
EGNER, FREDERIC.	Uniform Accounts, Report of Progress by Committee on	201
	What is the Business of a Gas Company?	206, 216
	Tar and Water from Water-Gas	229, 233
	Further Notes on Retort House Practice	243, 249
	Retort Ovens as Producers of Illuminating Gas	272, 285
	The Fuel Value of Residuals	287
FERRIER, JAMES	Final Resolutions, Report of Committee on	312
FORSTALL, ALFRED E.	Trustees Gas Educational Fund, Report of	169
	Uniform Accounts, Report of Progress by Committee on	199
	Tar and Water from Water-Gas	230
	What Records have we of Gas Holders having been Struck by Lightning, and What has been the Result?	234 235, 236, 237
	Further Notes on Retort House Practice	245, 249, 257
	A Comparison of Standards for Cast Iron Pipe and Specials	310
	Is the Method of Supporting Mantles in the Centre Superior to the Old Side-Rod Support?	311

SPEAKER.	SUBJECT.	PAGE.
FORSTALL, ALFRED E.	To What Temperature is it Economical to Heat Oils before they are Sprayed on the Checkerbrick? What are the Most Economical Means of Obtaining this Temperature?	311
	What is to be done with the Small Consumer, or rather the Would-be Small Consumer, who wants to use One Light or One 1-Burner Hot Plate?	311
FORSTALL, WALTON	What is the Business of a Gas Company?	208
	Bagging Live Gas Mains	259, 263, 264
	A Comparison of Standards for Cast Iron Pipe and Specials	288, 309
	Final Resolutions, Report of Committee on	313
FOWLER, S. J.	What Records have we of Gas Holders having been Struck by Lightning, and What has been the Result?	236
GANSER, H. H.	What is the Business of a Gas Company?	212
GIBBONS, P. H.	Bagging Live Gas Mains	259
GIFFORD, N. W.	Further Notes on Retort House Practice	243
	Do Many Gas Companies carry Liability or Accident Insurance, and is such Insurance Necessary or Desirable for Gas Companies?	266, 267
GREENOUGH, M. S.	Further Notes on Retort House Practice	240, 244, 254
	Retort Ovens as Producers of Illuminating Gas	277, 278
HARBISON, J. P.	Further Notes on Retort House Practice	255
	Committee on President's Address, Report of	259
HARPER, G. H	What is the Business of a Gas Company?	218
HINMAN, C. W	Is it Safe to Use Incandescent Electric Lights in a Purifying House, the Switchboard being outside of the Building, and the Wiring in Iron Pipes?	268
HOLMES, R. E	The Fuel Value of Residuals	287
HUMPHREYS, A. C	Uniform Accounts, Report of Progress by Committee on	190, 200

SPEAKER.	SUBJECT.	PAGE.
JENKINS, E. H.	Trustees Gas Educational Fund, Report of	169
	Tar and Water from Water-Gas	234
	Further Notes on Retort House Practice	257
	Place of Holding Next Meeting, Report of Committee on	257
KLUMPP, J. B	Tar and Water from Water-Gas	229
LEARNED, C. A	Is it Safe to Use Incandescent Electric Lights in a Purifying House, the Switchboard being outside of the Building, and the Wiring in Iron Pipes?	269
LITTLEHALES, T	What is the Business of a Gas Company?	211
	National Gas Advertising, Report of Committee on	222
	Bagging Live Gas Mains	265
	Retort Ovens as Producers of Illuminating Gas	278, 279, 285
LYNN, J. T	What is the Business of a Gas Company?	216
McILHENNY, J. D	Have Any Gas Companies sent out their Bills in Postal Card Form, Printed on the Back thereof, and if so, Does the Plan Work Satisfactorily? Does the Cheapening of Distributing the Bills and Facilitating the Office Work Offset the Objection of Undue Publicity of a Consumer's Account that such Form of Bill Involves?	312
McKAY, WM. E	Tar and Water from Water-Gas	225, 230, 233
MILLER, A. S	Officers Elect, Acknowledgment of Election by	189
	What is the Business of a Gas Company?	214
	Tar and Water from Water-Gas	226
	What Records have we of Gas Holders having been Struck by Lightning and What has been the Result?	236
	Retort Ovens as Producers of Illuminating Gas	273, 277
	The Fuel Value of Residuals	287
	A Comparison of Standards for Cast Iron Pipe and Specials	308
MILLER, CARROLL	Tar and Water from Water-Gas	230
	Further Notes on Retort House Practice	242
MILLER, W. A	Further Notes on Retort House Practice	239

P

SPEAKER.	SUBJECT.	PAGE.
MORRIS, W. C.	Tar and Water from Water-Gas	226
	The Fuel Value of Residuals	287
	A Comparison of Standards for Cast Iron Pipe and Specials	310
MORRISON, H. K	How Long is it Economical to Run a Lowe Water-Gas Apparatus without Cleaning the Checkerbrick? Is it Economical to Let Down the Machines for Twenty-four Hours Every Week in Order to Burn Out the Carbon which has Accumulated on the Checkerbrick?	270
MORTON, F. N.	Have Any Gas Companies Sent Out Their Bills in Postal Card Form, Printed on the Back thereof, and if so, Does the Plan Work Satisfactorily? Does the Cheapening of Distributing the Bills and Facilitating the Office Work Offset the Objection of Undue Publicity of a Consumer's Account that such Form of Bill Involves?	312
MOSES, F. D	What is the Business of a Gas Company?	219
	National Gas Advertising, Report of Committee on	220, 223
NETTLETON, C. H	Uniform Accounts, Report of Progress by Committee on	199
	Research Committee, Report of	203
	What Records have we of Gas Holders having been Struck by Lightning, and What has been the Result?	235
	Retort Ovens as Producers of Illuminating Gas	276
	The Fuel Value of Residuals	286, 288
NORRIS, ROLLIN.	Officers Elect, Acknowledgment of Election by	190
	Tar and Water from Water-Gas	228, 229
	How Long is it Economical to Run a Lowe Water-Gas Apparatus without Cleaning the Checkerbrick? Is it Economical to Let Down the Machines for Twenty-four Hours Every Week in Order to Burn Out the Carbon Which has Accumulated on the Checkerbrick?	269
	The Fuel Value of Residuals	286

SPEAKER.	SUBJECT.	PAGE
Nute, J. E	How Long is it Economical to Run a Lowe Water-Gas Apparatus without Cleaning the Checkerbrick? Is it Economical to Let Down the Machines for Twenty-four Hours Every Week in Order to Burn Out the Carbon which has Accumulated on the Checkerbrick?	270
Persons, F. R	What is the Business of a Gas Company?	212
	National Gas Advertising, Report of Committee on,	221, 223
Pratt, Edward G.	Election of Members	12
	Trustees Gas Educational Fund, Report of	169
	President's Address	170
	Nominations, Report of Committee on	189
	Uniform Accounts, Report of Progress by Committee on	198
	Sergeant-at-Arms, Announcement by President of Appointment of	201
	Research Committee, Report of	203
	What is the Business of a Gas Company?	203, 205, 211, 218
	Tar and Water from Water-Gas	225, 226, 230, 233
	What Records have we of Gas Holders having been Struck by Lightning, and What has been the Result?	234
	Further Notes on Retort House Practice	238, 240, 243, 253
	Place of Holding Next Meeting, Report of Committee on	258
	Is it safe to Use Incandescent Electric Lights in a Purifying House, the Switch-board being outside of the Building, and the Wiring in Iron Pipes?	268
	Retort Ovens as Producers of Illuminating Gas	270
	The Fuel Value of Residuals	286, 287
	A Comparison of Standards for Cast Iron Pipe and Specials	308, 309, 310
	Is the Method of Supporting Mantles in the Centre Superior to the Old Side-Rod Support?	311

R

SPEAKER.	SUBJECT.	PAGE.
PRATT, EDWARD G.	To What Temperature is it Economical to Heat Oils before they are Sprayed on the Checkerbrick? What are the Most Economical Means of Obtaining this Temperature?	311
	Have Any Gas Companies Sent Out their Bills in Postal Card Form, Printed on the Back thereof, and if so, Does the Plan Work Satisfactorily? Does the Cheapening of Distributing the Bills and Facilitating the Office Work Offset the Objection of Undue Publicity of a Consumer's Account that such Form of Bill Involves?	312
PRICHARD, C. F.	The Fuel Value of Residuals	287
RICE, H. L	What is the Business of a Gas Company?	209, 217
ROBISON, C. D.	What is the Business of a Gas Company?	210
	What Records have we of Gas Holders having been Struck by Lightning, and What has been the Result?	234
RUSSELL, D. R.	Further Notes on Retort House Practice	243
SEARLE, R. M.	What is the Business of a Gas Company?	210, 211, 214
	Further Notes on Retort House Practice	249
	Retort Ovens as Producers of Illuminating Gas	279
	What is to be Done with the Small Consumer, or rather the Would-be Small Consumer, who Wants to Use One Light or One 1-Burner Hot Plate?	311, 312
SEYMOUR, W. W.	Retort Ovens as Producers of Illuminating Gas	277
SHELTON, F. H.	Election of Honorary Members	14
	Uniform Accounts, Report of Progress by Committee on	198
	What is the Business of a Gas Company?	218
	National Gas Advertising, Report of Committee on	222
	Retort Ovens as Producers of Illuminating Gas	284
SHERMAN, F. C.	The Fuel Value of Residuals	286

SPEAKER.	SUBJECT.	PAGE.
Spragle, L. D	What is the Business of a Gas Company?	205
	Is it Safe to Use Incandescent Electric Lights in a Purifying House, the Switch-board being outside of the Building, and the Wiring in Iron Pipes?	268
Taber, Robt. B	What Records have we of Gas-Holders having been Struck by Lightning, and What has been the Result?	235
Wheeler, F. B	Further Notes on Retort House Practice	249
White, Wm. Henry	Election of Members	12
	Council, Report of	14
	Treasurer and Finance Committee, Report of	14
	Secretary, Report of	14
	President's Address, Appointment of Committee on	188
	Nominations, Report of Committee on	189
	National Gas Advertising, Report of Committee on	222, 224
	Further Notes on Retort House Practice	250
	Place of Holding Next Meeting, Report of Committee on	257
	Committee on President's Address, Report of	258
Williamson, John	What Records have we of Gas Holders having been Struck by Lightning and What has been the Result?	236
Witherby, E. E	Uniform Accounts, Report of Progress by Committee on	200
	What is the Business of a Gas Company?	215
	Is it Safe to Use Incandescent Electric Lights in a Purifying House, the Switchboard being outside of the Building, and the Wiring in Iron Pipes?	267, 268

ERRATA.

Page 85. Line 10 from bottom *for* "C_2 H^4" *read* "C_2 H_4."

" 114. First line *for* "%" *read* "°."

" 229. Line 4 from bottom *for* "tax" *read* "tar."

" 277. Line 21 from top *for* "Littlefield" *read* "Littlehales."

Edward Leute

THE PROCEEDINGS

OF THE

American Gas Light Association.

TWENTY-NINTH ANNUAL MEETING,

HELD AT

STEINERT HALL, BOSTON,

OCTOBER 16TH TO 18TH, 1901.

FIRST DAY—MORNING SESSION.

The Association was called to order at ten o'clock A. M. by the President, Mr. Edward G. Pratt.

The following members were in attendance.

Honorary Members.

Barker, Forrest E.,	Boston, Mass.

Active Members.

Addicks, Walter R.,	Boston, Mass.
Africa, Walter G.,	Manchester, N. H.
Arthur, F. M.,	Philadelphia, Pa.
Baehr, Wm. A.,	Denver, Colo.
Barrett, W. E.,	Ardmore, Pa.
Battin, H. S.,	Philadelphia, Pa.
Beal, William R.,	New York, N. Y.
Bell, Ernest Wm.,	St. Louis, Mo.
Blinks, Walter M.,	Michigan City, Ind.
Blodget, Charles W.,	Providence, R. I.
Brown, Ernest C.,	New York, N. Y.
Brundrett, E. L.,	Philadelphia, Pa.
Buck, David, Jr.,	Phœnixville, Pa.
Buck, H. M.,	Waukesha, Wis.

Buckman, James,	Philadelphia, Pa.
Butterworth, Irvin,	Denver, Colo.
Callanan, John M.,	Chester, Pa.
Capelle, George S.,	Wilmington, Del.
Cathels, Edmund,	Hamilton, Ont.
Clark, Walton,	Philadelphia, Pa.
Clarke, George S.,	Kansas City, Mo.
Clary, Edward D.,	Burlington, Iowa.
Coates, John R.,	Ottawa, Ont., Canada.
Coffin, John A.,	Gloucester, Mass.
Coggshall, H. F.,	Fitchburg, Mass.
Cooke, Alfred S.,	New York, N. Y.
Cooper, Wm. H.,	Amsterdam, N. Y.
Cosgrove, W. L.,	Atlanta, Ga.
Cowdery, E. G.,	Milwaukee, Wis.
Coyle, Patrick,	Charlestown, Mass.
Cressler, A. D.,	Fort Wayne, Ind.
Curley, Thomas,	Wilmington, Del.
Curtis, Samuel Philip,	Philadelphia, Pa.
Daly, David R.,	Jersey City, N. J.
Daniels, John M.,	Columbia, S. C.
Davis, Fred. J.,	Boston, Mass.
Dell, John,	St. Louis, Mo.
Dickey, Chas. H.,	Baltimore, Md.
Donahue, E. J.,	Philadelphia, Pa.
Dunbar, Carl H.,	Elgin, Ill.
Dutton, Lewis R.,	Wyncote, Pa.
Dutton, R. Hayes,	Hanover, Pa.
Earnshaw, Edward H.,	Philadelphia, Pa.
Egner, Frederic,	Norfolk, Va.
Ferrier, James,	Columbus, Ga.
Fitz, Robert F.,	Elgin, Ill.
Flemming, Dudley D.,	Jersey City, N. J.
Floyd, Fred. W.,	New York, N. Y.
Forstall, Alfred E.,	New York, N. Y.
Forstall, Walton,	Philadelphia, Pa.
Fowler, Samuel J.,	Boston, Mass.
Frueauff, Frank W.,	Denver, Colo.
Gates, Frederick W.,	Hamilton, Ont., Canada.
Geggie, David H.,	Quebec, Canada.

Gerould, Charles L.,	Galesburg, Ill.
Gifford, Nathaniel W.,	New Bedford, Mass.
Glasgow, Arthur G.,	London, Eng.
Golden, John W.,	Savannah, Ga.
Graf, Carl H.,	Hackensack, N. J.
Greenough, Malcolm S.,	Cleveland, Ohio.
Gribbel, John,	Philadelphia, Pa.
Guldlin, Olaf N.,	Fort Wayne, Ind.
Hadden, Jas. M.,	Poughkeepsie, N. Y.
Harbison, John P.,	Hartford, Conn.
Harper, George H.,	Altoona, Pa.
Holmes, Rufus E.,	Winsted, Conn.
Holzer, E. G.,	Easton, Pa.
Horton, Thos. O.,	Stapleton, N. Y.
Humphreys, Alex. C.,	New York, N. Y.
Humphreys C. J. R.,	Lawrence, Mass.
Jenkins, E. H.,	San Antonio, Texas.
Jourdan, James H.,	Brooklyn, N. Y.
Kellogg, L. L.,	Sioux City, Iowa.
Keppelman, John H.,	Reading, Pa.
Klumpp, John B.,	Omaha, Neb.
Knowles, W. P.,	Richmond, Va.
Lamson, Charles D.,	Worcester, Mass.
Leach, Henry B.,	Taunton, Mass.
Learned, Charles A.,	Meriden, Conn.
Learned, Waldo A.,	Newton, Mass.
Leonard, Chas. F.,	Fall River, Mass.
Lillie, Lewis,	Philadelphia, Pa.
Littlehales, Thomas,	Syracuse, N. Y.
Lynn, James T.,	Detroit, Mich.
McDonald, William,	Albany, N. Y.
McIlhenny, John D.,	Philadelphia, Pa.
McKay, William E.,	Dorchester, Mass.
Mann, Howard E.,	Cleveland, Ohio.
Max Wm. J.,	Middletown, N. Y.
Mayers, J. Alex.,	New York, N. Y.
Merrifield, L. L.,	Toronto, Canada.
Miller, Alten S.,	New York, N. Y.
Miller, Carroll,	Chicago, Ill.
Miller, William A.,	Cincinnati, Ohio.

Mitchell, Kerr M.,	St. Joseph, Mo.
Morrell, E. E.,	Oak Park, Ill.
Morris, W. Cullen,	Long Island City, N. Y.
Morrison, H. K.,	Concord, N. H.
Morton, Fred. N.,	Hoboken, N. J.
Moses, Frank D.,	Trenton, N. J.
Nettleton, Chas. H.,	Derby, Conn.
Norris, Rollin,	Philadelphia, Pa.
Norton, W. F.,	Nashua, N. H.
Nute, Joseph E.,	Fall River, Mass.
Nutting, Chas. H.,	Chicopee, Mass.
Page, Carter H., Jr.,	Philadelphia, Pa.
Paullins, Wm. C.,	Colorado Springs, Colo.
Pearson, William H.,	Toronto, Ont.
Pratt, Edward G.,	Des Moines, Iowa.
Prichard, Charles F.,	Lynn, Mass.
Quinn, Andrew K.,	Newport, R. I.
Ramsdell, George G.,	Philadelphia, Pa.
Randolph, William W.,	New York, N. Y.
Rice, Henry L.,	Norfolk, Va.
Richardson, Frank S.,	North Adams, Mass.
Riselay, Wm. S.,	Buffalo, N. Y.
Roberts, George J.,	Philadelphia, Pa.
Robison, C. D.,	Geneva, N. Y.
Ross, Alexander,	St. Louis, Mo.
Rossman, G. M.,	Keene, N. H.
Rowland, William L.,	Philadelphia, Pa.
Russell, Daniel R.,	St. Louis, Mo.
Sabbaton, F. A.,	Glens Falls, N. Y.
Searle, R. M.,	Mount Vernon N. Y.
Seaverns, F.,	New York, N. Y.
Shattuck, John D.,	Darby, Pa.
Shelton F. H.,	Philadelphia, Pa.
Sherman, F. C.,	New Haven, Conn.
Slade, Richmond E.,	Lockport, N. Y.
Slater, A. B.	Providence, R. I.
Slater, A. B., Jr.,	Boston, Mass.
Slater, Howard C.,	Boston, Mass.
Smart, Fred. R., Jr.,	York, Pa.
Snow, William H.,	Holyoke, Mass.

Spangenberg, B. H.,	Philadelphia, Pa.
Spaulding, Chas. F.,	Waltham, Mass.
Spinning, W. V.,	Peru, Ind.
Spragle, L. D.,	Johnstown, N. Y.
Stilwell, B. W.,	Yonkers, N. Y.
Strong, C. D.,	Long Branch, N. J.
Stroud, Morris W.,	Philadelphia, Pa.
Thwing, O. O.,	St. Louis, Mo.
Tobey, Franklin, Jr.,	Kingston, N. Y.
Tuttle, Wm. B.,	Long Branch, N. J.
Waldo, Charles S.,	Boston, Mass.
Walker, Edw. M.,	Hyde Park, Mass.
Walters, Benj. S.,	Philadelphia, Pa.
Warmington, Daniel R.,	Cleveland, Ohio.
Weber, Oscar B.,	New York, N. Y.
Westcott, John T.,	London, Eng.
Wharton, W. S.,	Whatcom, Wash.
Wheeler, Fred. B.,	Binghamton, N. Y.
Whipple, Henry S.,	Rockford, Ill.
White, Chas. E.,	Wakefield, Mass.
White, Wm. Henry,	New York, N. Y.
Wilcox, John F.,	Cleveland, Ohio.
Williams, E. H.,	Waterbury, Conn.
Williams, L. S.,	Harrisburg, Pa.
Williams, W. L.,	Paterson, N. J.
Williamson, John,	Chicago, Ill.
Witherby, Edwin E.,	New York, N. Y.
Wood, Stuart,	Philadelphia, Pa.
Wood, William A.,	Boston, Mass.
Woodward, Ralph,	Philadelphia, Pa.
Yorke, Eugene H.,	Portland, Me.
Young, Percy S.,	Jersey City, N. J.
Young, Peter,	Detroit, Mich.
Zeek, Charles F.,	Pensacola, Fla.

Associate Members.

Allen, Walter S.,	New Bedford, Mass.
Atwater, C. G.,	New York, N. Y.
Cartwright, Henry R.,	Philadelphia, Pa.
Coburn, Cyrus M.,	Chelsea, Mass.

Coleman, H. W.,	Philadelphia, Pa.
Collins, David J.,	Philadelphia, Pa.
Crane, William M.,	New York, N. Y.
Curley, Edward J.,	Wilmington, Del.
Dickey, Edmund S.,	Baltimore, Md.
Eaton, Alfred B.,	Chicago, Ill.
Fisk, John T.,	Concord, N. H.
Graves, George W.,	Rochester, N. Y.
Guenther, Carl M.,	Philadelphia, Pa.
Harper, H. D.,	Chicago, Ill.
Hayward, S. F.,	New York, N. Y.
Higgins, C. M.,	New York, N. Y.
Hinman, C. W.,	Boston, Mass.
Jacobs, Chas. H.,	Detroit, Mich.
Luqueer, Robt. O.,	New York, N. Y.
McDonald, Donald,	Albany, N. Y.
Mansur, John H.,	Royersford, Pa.
Mueller, Robt.,	Decatur, Ill.
Norton, Arthur F.,	Boston, Mass.
Norton, Harry A.,	Boston, Mass.
Pearson, J. A.,	Philadelphia, Pa.
Persons, F. R.,	Toledo, Ohio.
Prendergast, Daniel J.,	New York, N. Y.
Roper, George D.,	Rockford, Ill.
Steward, Robt. Bruce,	Chattanooga, Tenn.
Tolman, Wm. Nichols,	Philadelphia, Pa.
Van Wie, E. G.,	Detroit, Mich.
Wells, Fred. K.,	Chicago, Ill.
Wharton, Henry,	Philadelphia, Pa.

The President:—The first business in order this morning will be the reading of the minutes of the last annual meeting.

Mr. Kellogg:—I move that the reading of the minutes be dispensed with, inasmuch as they have been published in the Proceedings of the Association.

Carried.

The President:—Next in order will be the reading of the report of the Council on Applications for Membership and Transfers of Membership.

The Secretary read the following report:

BOSTON, October 16, 1901.

To the American Gas Light Association,

GENTLEMEN:—Your Council has approved the following applications for membership, and submit them to you with the recommendation that they receive favorable action.

Proposed for Active Membership.

* Allen, William H., No. 575 Broad St., Newark, N. J., Commercial Agent of Essex & Hudson Gas Company.

* Allyn, Horace A., Third St., East Cambridge, Mass., Superintendent of Cambridge Gas Light Company.

Apperson, Richard D., Lynchburg, Va., President of The Lynchburg Gas Company, The Petersburg Gas Company, and The Columbia Gas Light Company.

Blake, S. N., No. 501 Realty Building, Elmira, N. Y., President Norwich (N. Y.) Gas & Electric Company, and Treasurer of Dansville Gas & Electric Company.

Brown, W. O., Phillipsburg, N. J., Superintendent of Peoples Light, Heat and Power Company.

Burrage, Charles D., No. 24 West St., Boston, Mass., Vice-President and Secretary of the Boston Gas Light Company, South Boston Gas Light Company, Roxbury Gas Light Company, and the Bay State Gas Company.

* Butterworth, C. W., St. Albans, Vt., Superintendent of St. Albans Gas Light Company.

Case, Willard E., Auburn, N. Y., Vice-President of American Light and Traction Company.

Chandler, Frank E., Medford, Mass., President and General Manager of Malden & Melrose Gas Light Company.

Childs, Arthur E., No. 23 Central St., Boston, Mass., President of Delaware Gas Light Company (Easton, Pa.)

* Clabaugh, G. W., Omaha, Neb., Secretary of the Omaha Gas Company.

Clark, Thomas H., Spencer, Mass., Superintendent of Spencer Gas Company.

* Present at meeting.

* Crafts, H. C., No. 216 Main St., Northampton, Mass., Superintendent of Northampton Gas Light Company.

* Curran, G. W., No. 115 Hawthorne Ave., Yonkers, N. Y., Auditor of Westchester Lighting Company.

Dawson, George H., No. 285 Court St., Binghamton, N. Y., Superintendent of Binghamton Gas Works.

* Dole, Charles E., Bangor, Me., Superintendent of Bangor Gas Light Company.

* Dunn, Frank S., No. 1131 Broadway, Albany, N. Y., Superintendent of Municipal Gas Company of Albany.

* Dusenberry, J. P., Newark, N. J., Secretary of the Essex & Hudson Gas Company.

* Eysenbach, Ernest E., Columbus, Ohio, Superintendent of Columbus Gas Company.

* Forbes, Charles, London, Ontario, Canada, Superintendent of City Gas Company.

* Ganser, Herbert H., Norristown, Pa., Superintendent of Gas Company of Montgomery County.

Goodnow, George F., Waukegan, Ill., General Manager of the North Shore Gas Company.

* Gould, John A., No. 24 West St., Boston, Mass., Chief Engineer of the Brookline and Dorchester Gas Light Companies.

* Hilleke, August F., Everett, Mass., Assistant Superintendent of the New England Gas and Coke Company.

* Knight, J. J., Kalamazoo, Mich., General Manager of the Kalamazoo Gas Company.

Light, George, No. 205 East First St., Dayton, Ohio, Assistant Superintendent of the Dayton Gas Light and Coke Company.

* Linton, S. E., Jr., Sag Harbor, N. Y., Superintendent of the Sag Harbor Gas Works, The United Gas Improvement Company.

* Macmun, G. F., Marlboro, Mass., General Manager of the Marlboro Gas Light Company.

Motley, George S., Lowell, Mass., Treasurer of The Lowell Gas Light Company.

* Old, George, St. Augustine, Fla., Superintendent of the St. Augustine Gas and Electric Light Company.

* Present at meeting.

* Pollitt, L. I., Pine Bluff, Ark., Manager of the Pine Bluff Light and Water Company.

* Powers, Edgar T., Lincoln, Neb., General Manager of the Lincoln Gas and Electric Company.

Ruggles, C. S. J., Gardner, Mass., Superintendent of the Gardner Gas Company.

Sargent, Fred H., Lawrence, Mass., Superintendent of the Lawrence Gas Company.

Secord, W. L., No. 42 Washington Ave., New Rochelle, N. Y., Chief Clerk in charge of Distribution New Rochelle District of the Westchester Lighting Company.

* Seymour, William W., Tacoma, Wash., President Tacoma Gas and Electric Light Company.

* Stratton, F. A., Mount Vernon, N. Y., Vice-President of the Westchester Lighting Company, Hudson River Gas and Electric Company, White Plains Lighting Company.

Taussig, J. Hawley, Newark, N. J., Superintendent of the Market Street Works of the Essex and Hudson Gas Company.

Taylor, J. D., Jr., Pueblo, Colo., Secretary and General Manager of the Pueblo Gas Light Company.

* Thompson, F. deV., Springfield, Mass., General Manager of the Springfield Gas Light Company.

Tippy, B. O., Detroit, Mich., Superintendent of the Detroit City Gas Campany.

Tull, Lucien P. F., No. 340 Third Ave., New York, N. Y., Auditor of the New Amsterdam Gas Company.

* Walker, Sidney R., No. 401 Centre St., Bay City, Mich., Superintendent of the Bay City Gas Company.

* Waring, George H., Jr., Savannah, Ga., Superintendent of the Mutual Gas Light Company.

Williams, Herbert G., No. 37 South Thirteenth Ave., Mount Vernon, N. Y., Agent Westchester Lighting Company.

* Wood, T. B., Sixth and Provost Sts., Jersey City, N. J., Superintendent of the Jersey City Works of the Hudson County Gas Company.

* Present at meeting.

Young, Richard R., No. 185 Main Ave., Passaic, N. J., Agent for the Passaic District of The Paterson and Passaic Gas and Electric Company.

* Young, Robert, Jr., No. 327 Spring St., Atlanta, Ga., Superintendent of the Atlanta Gas Light Company.

Proposed for Associate Membership.

Baldwin, Chas. H., 159 Franklin St., Boston, Mass., P. O. Box 2,410, Manager of the National Meter Co., Manufacturers Gas Engines and Water Meters.

* Barrows, George Shattuck, Gloucester City, N. J., Engineer of the Welsbach Light Company.

* Bassett, Frank A., Bridgeport, Conn., P. O. Box 12, Sales Agent Righter and Marshall.

* Bernstein, S , 82 West Broadway, New York, N. Y., President of The S. Bernstein Company.

* Burchard, Lewis Sayre, 6 Wall St., New York, N.Y., President and Treasurer of the Webber Prepayment Attachment Company.

Chaney, Franklin V., 28 Oliver St., Boston, Mass., Publisher of Gas Literature, Home Science Publishing Company.

Dickel, Wm. L., 136 Liberty St., New York, N. Y., President of the Boulevard Globe and Lamp Company.

* Dods, John C., 915 Wainwright Building, St. Louis, Mo., Engineer with the Laclede Fire Brick Manufacturing Company.

* Hunter, Harry W., 851 Equitable Building, Baltimore, Md., Salesman of F. & L. Kahn & Bros., Hamilton, Ohio.

Leakey, Nathan G., Detroit, Mich., Assistant Secretary and Treasurer of the Michigan Ammonia Works.

* Lippincott, Wilbur M., 212 West 114th St., N. Y., Salesman of the American Incandescent Gas Company.

* McIlravy, W. N., 100 William St., New York, N. Y., Agent of the National Coal Tar Company.

* Marsh, Converse D., 136 Liberty St., New York, N. Y., President of Bryan-Marsh Company, Manufacturer of Photometers.

* Mills, Wm. A., Portchester, N. Y., Secretary of Abendroth Brothers.

* Present at meeting.

* Nichols, Carroll B., 224 South Third St., Philadelphia, Pa., Salesman of the Westmoreland Coal Company.

* Palmer, George Q., 742 East 12th St., New York, N. Y., Manager of the Quintard Iron Works.

* Potter, T. J., Cleveland, Ohio, Salesman of the Standard Lighting Company.

Roberts, Clarence V., 3d and Mifflin Sts., Philadelphia, Pa., Vice-President of the Thomas, Roberts, Stevenson Company.

* Rodgers, E. H., 942-944 Drexel Building, Philadelphia, Pa., Treasurer of the Standard Meter Company.

Stroh, George, Detroit, Mich., Superintendent of the Michigan Ammonia Works.

* Terhune, Chas. F., 1133 Broadway, New York, N. Y., Vice-President of Wm. M. Crane Company.

* Webber, Wesley, 6 Wall St., New York, N. Y., Engineer of the Webber Prepayment Attachment Company.

Welch, John S., N.W. cor. Broad and Arch Sts., Philadelphia, Pa., Gas Engine Expert, with the United Gas Improvement Company.

* Wickham, Leigh, St. Louis, Mo., Salesman of the Parker-Russell Mining & Manufacturing Company.

Wilkinson, C. T., Brockville, Ontario, Canada, Consulting Gas and Electric Engineer.

Transfers from Associate to Active.

Collins, David J., 1403 Arch St., Philadelphia, Pa., P. O. Box 1564, Sales Agent and Consulting Engineer of the United Gas Improvement Company.

Mansur, John H., Royersford, Pa., President of the Consolidated Schuylkill Gas Company.

Roper, George D., Rockford, Ill., Vice-President of the Boone Gas Company, Boone, Iowa.

Number of Applications—Active	48
" " " Associate	25
Total	73
Transfers	3

Respectfully submitted for the Council,

ALFRED E. FORSTALL, *Secretary.*

E. G. PRATT, *President.*

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* Present at Meeting.

On motion of Mr. White, the Secretary was directed to cast the ballot of the Association for the election of those named in the report. Mr. Lewis Lillie and Mr. E. C. Brown were appointed tellers; the ballot was cast by the Secretary as directed, and the applicants were declared duly elected members of the Association.

THE PRESIDENT:—Gentlemen, you have elected the members recommended by the Council. If any of those gentlemen are present I would ask them to rise in their seats. I desire to say to you, gentlemen, that the Association welcomes you to membership, with the hope that your connection with us may be of mutual benefit; and especially that you may receive benefits from the Association that will cause you to be thankful that you have become members. We greet you.

The next business in order is the report of the Council on the management of the affairs of the Association during the past year.

The Secretary read the following:

REPORT OF COUNCIL.

BOSTON, October 16, 1901.

To the American Gas Light Association,

GENTLEMEN:—Your Council has the honor to make its annual report as follows:—

A separate report upon applications for membership recommends the election of 73 applicants.

We recommend the election to honorary membership of Dr. H. Bunte and of Herr W. Von Oechelhaeuser Dr. Bunte has probably done as much work in chemical and scientific investigation into the processes of gas manufacture as any other one man connected with the industry; and Herr Von Oechelhaeuser, as manager of the German Continental Gas Company, has been foremost in the ranks of German Gas Engineers.

The resignations of seven active and three associate members have been received and accepted during the year.

The following list of papers has been approved to be read at this meeting.

"The Analysis of Gas Accounts," by Paul Doty, Detroit, Mich.

"What is the Business of a Gas Company?" by Frank D, Moses, Trenton, N. J.

"Tar and Water from Water-Gas," by William E. McKay, Dorchester, Mass.

"Retort Ovens as Producers of Illuminating Gas," by T. Littlehales, Syracuse, N. Y.

"Further Notes on Retort House Practice," by E. H. Earnshaw, Philadelphia, Pa.

"The Fuel Value of Residuals," by C. F. Prichard, Lynn, Mass.

Also the following short topics:

"Bagging Live Gas Mains," by Mr. P. H. Gibbons, of Philadelphia, Pa.

"A Discussion of the Differences between Two Sets of Standards for Cast Iron Pipes and Fittings," by Mr. Walton Forstall, of Philadelphia, Pa.

We regret that the efforts made to arrange for a lecture to be delivered before the Association during the meeting, have not been successful.

In accordance with the instructions of the Association as voted at the last meeting, the Secretary sent to all the active members of the Association letters asking their opinion as to the suitability of the cast iron pipe and fittings standards of the Association and their willingness to insist on being furnished with pipe and fittings conforming to the standard. Out of a total of 461 members addressed he has received replies from 99, of whom 59 approved of, 6 did not approve of, and 34 partially approved of, were doubtful about, or did not care to express their views as to the standards. Owing to the small number of members heard from in approval he exercised the discretion given him as to carrying out the remainder of the instructions contained in the resolutions mentioned above, and did not write the pipe manufacturers. In view of these facts it was thought well to again bring the matter before the Association; and it was referred to the Research Committee with the request that they report on it at this meeting of the Association.

At the last meeting of the Association, the President, Mr. Ramsdell, was authorized to appoint a Committee of three to consider the question of a system of uniform accounts for gas companies. This Committee was appointed as follows:

A. C. Humphreys, *Chairman*,
Lewis Lillie,
A. P. Lathrop,

and it will make a report at this meeting.

Respectfully submitted,

Alfred E. Forstall,
Secretary.

Edward G. Pratt,
President.

Mr. White moved that the report be received, placed on file, and the recommendations acted upon seriatim.

Carried.

On motion of Mr. Shelton the Secretary was directed to cast the ballot of the Association for the election of Dr. H. Bunte and of W. Von Oechelhaeuser to honorary membership in the Association, as recommended by the Council. Mr. A. S Miller and Mr. Walton Forstall were appointed tellers; the ballot was cast by the Secretary as directed, and the gentlemen named were declared duly elected honorary members of the Association.

The Secretary read the following reports of the Treasurer and Secretary, and the report of the Finance Committee, which were on motion of Mr. White received and placed on file.

Report of Treasurer for Year Ending Sept. 30, 1901.

Receipts.

Dues for year 1898	$ 10 00	
" " 1899	60 00	
" " 1900	155 00	
" " 1901	2,408 47	
" " 1902	5 47	
		$2,638 94
Life Membership		50 00
Initiation Fees, Members elected October 17, 1900		470 00
Sale of Proceedings		197 65
" Badges		7 00
" Williams Typewriter		65 00
Interest on Deposit in Savings Bank		35 17
Total receipts		$3,463 76
Cash balance from last year		859 11
Total		$4,322 87

Expenditures.

Expense of 28th Annual Meeting		$ 312 70
Report of 28th Annual Meeting and Report of Council Meeting October 16, 1900		240 00
Expense of Council Meeting May 14, 1901		61 61
Report of Council Meeting May 14, 1901		22 00
Publishing Proceedings, Vol. XVII		1,029 60
Distribution of Proceedings, Vol. XVII		133 45
Printing Advance Copies of Papers		33 00
Distribution of Advance Copies of Papers		5 50
Subscription to Educational Fund		250 00
Salary of Secretary and Treasurer		600 00
R. R. Agent for 29th Annual Meeting		17 00
Subscriptions to Publications		12 92
Binding Periodicals		7 50
Miscellaneous Printing, Circulars, Programmes, etc.		98 15
Postage Stamps and Stamped Envelopes		104 82
Membership Badges		196 00
Stationery		22 25
Telephone and Telegrams		14 95
Expressage		8 69
Office Expenses		8 67
Williams Typewriter		62 50
Book Cases		20 50
Total		$3,261 81
Total Receipts		4,322 87
Total Expenditures		3,261 81
Balance		$1,061 06
Net Balance in National Newark Banking Company, as per bank book	$ 54 14	
Cash in Savings Bank	1,006 92	
		$1,061 06

Respectfully submitted by

ALFRED E. FORSTALL,

Treasurer.

Boston, Mass., Oct. 16, 1901.

We, the undersigned members of the Finance Committee of the American Gas Light Association, have this day examined the books and accounts of Alfred E. Forstall, Secretary and Treasurer, for the year ending September 30, 1901, and have found the same to be correct.

Wm. R. Beal, *Chairman*,
Rollin Norris.

Finance Committee.

Membership Report of Secretary for Year Ending Sept. 30, 1901.

Honorary Members.

On Roll October 1, 1900	8		
Elected October 17, 1900	2		
On Roll September 30, 1901			10

Active Members.

On Roll October 1, 1900	437		
Elected October 17, 1900	36		
Transferred from Associate to Active October 17, 1901	1		
		474	
Dropped from Roll October 16 to February 18,	7		
Resigned during year	7		
Died during year	8		
		22	
On Roll September 30, 1901			452

Associate Members.

On Roll October 1, 1900	75		
Elected October 17, 1900	12		
		87	
Dropped from Roll December 27, 1900	1		
Transferred from Associate to Active October 17, 1900	1		
Did not qualify	1		
Resigned during year	3		
Died during year	2		
		8	
On Roll September 30, 1901			79
Total Membership September 30, 1901.			541

Deceased.

Active.

G. W. Abel, Atlanta, Ga., December 21, 1900.
A. C. Gandey, Lambertville, N. J., December 30, 1900.
David W. Crafts, Northampton, Mass., March 12, 1901.
C. C. Fry, Lynn, Mass., March 21, 1901.
William Stacey, Cincinnati, Ohio, June 17, 1901.
James Slade, Yonkers, N. Y., June 18, 1901.
George B. Neal, Charlestown, Mass., July 7, 1901.

Previously reported but included in the above report,
Geo. Treadway Thompson, Denver, Colo., October 1, 1900.

Death not included in the above Membership Report,
Wm. Wallace Goodwin, Philadelphia, Pa., October 6, 1901.

Associate.

Harold Humphreys, New York, N. Y., February 12, 1901.
Wm. E. Barrows, Philadelphia, Pa., July 30, 1901.

Dropped by Action of Council.

Active.

Jas. R. Floyd	New York, N. Y.
T. S. C. Lowe	Pasadena, Cal.
Anthony Watt	Connersville, Ind.
Zeuner M. Jenks	Woonsocket, R. I.
Wm. H. Spaulding	Clinton, Mass.
James H. Walker	Milwaukee, Wis.
Clement A. White	Chicago, Ill.

Associate.

James S. Manning	New York, N. Y.

The President:—The next business will be the report of Special Committees.

The Secretary:—Under this head is usually read the Report of the Trustees Gas Educational Fund to the Association and to the subscribers to the Fund. Although properly and technically speaking the Trustees are not a Special Committee of this Association, being a separate organization, it has nevertheless been customary to present their report under this order of business.

THIRD ANNUAL REPORT OF THE TRUSTEES GAS EDUCATIONAL FUND TO THE AMERICAN GAS LIGHT ASSOCIATION AND OTHER SUBSCRIBERS TO THE FUND.

To the American Gas Light Association and Subscribers :

GENTLEMEN :—The Trustees appointed at the Twenty-sixth Annual Meeting of the American Gas Light Association, held October 17, 1898, to administer the Educational Fund formed by your subscriptions, submit the following Report as to the work done from October 1, 1900, to September 30, 1901.

The main object for which the Fund was raised, that of encouraging and guiding the efforts of those employees of gas companies, who, lacking the advantages of an extended education, are anxious to acquire knowledge that will be of service to them in their work, has been provided for, as before, by the Correspondence Class working under the direction of the Secretary. This Class now contains three sections, known as the Second, Third and Fourth Sections, the Second Section being in its third year, the Third in its second year and the Fourth in its first year of work. Each of these sections receives its own set of questions, which are made to differ as much as possible from those sent to the other sections, although each section covers the same ground during its three years' course as has been covered by preceding sections. The Second Section will complete its work at the end of this year and a Fifth Section will be formed at the same time from new applicants for admission to the class.

In September, 1900, a rule was made that in the future no graduates of a university or technical college would be admitted to full membership in the class, but that any such applicants could, upon payment of an annual fee of $5, be admitted to a Special Section, the members of which would receive the questions and answers as issued, but would not be entitled to the individual attention given to the regular members. The object of this rule is to make it certain that the benefits of the work will accrue chiefly to those who, having had the fewest educational advantages, are therefore the most in need of the assistance that is given by the work of the class.

The other rules governing admission to, and continuance of, membership in the class are as follows:

Eligibility for and Admission to Membership.

Only employees of gas companies are eligible for membership in the class.

Employees of gas companies who are not graduates of Universities or Technical Schools, nor holders of degrees from Colleges are eligible for membership with the full privileges of the Class without the payment of any fee.

To secure admission to either the regular or special class, a person eligible for membership in such class must file an application, made according to a prescribed form, copies of which will be furnished by the Secretary upon request, and endorsed by a member of the American Gas Light Association or a Subscriber to the Fund. In cases where a subscription is made in the name of a Company, any of the executive officers of such Company shall be entitled to endorse applications for membership in the Class.

All applications will be considered by the Secretary, who will admit to the Class applicants whose applications, being in proper from and properly endorsed, show them to be entitled to membership.

When applications are received after the beginning of a class year, but before the first of June, the applicants will be admitted to membership in that section of the Class which began work upon the first of January immediately preceding the date of their applications, upon condition that they take up and carry on the work in such manner as to complete and send in answers to all the questions sent out to such section during the first year, on or before the first of January next following the receipt of the applications.

Applicants applying for admission after the first of June will not be admitted to the class before the beginning of the next class year. The class year corresponds with the calendar year.

Continuance in Class.

Any member of the class who fails to send in his answers to any set of questions within the time specified for the receipt of such answers, and does not furnish to the Secretary a good reason for such failure and secure an extension of time in which to send in these answers, or having secured such an extension of time in which to send in the answers to any set of questions, fails to send in such answers within such extended time, forfeits his membership in, and shall be dropped from, the class. A member so dropped, if still eligible for membership, may, upon application, re enter the class as a member of the next section formed, either at the beginning of the next class year, or at a point during such year corresponding to that at which his membership ceased in the preceding year.

Members of the class who send in answers to each set of questions issued within the time originally specified for the receipt of such answers, or within any extended time which may be granted to them, will be continued in the class for three years, but at the end of this time their membership shall cease by limitation.

Method of Instruction.

A set of twelve questions is sent out each three months. Answers to each set of questions are due within two months after the date at which it is sent out. In the preparation of their answers the members of the class are at liberty to use any and all sources of information at their command, except the answers to such questions as have been previously used, which are published in the Proceedings of the American Gas Light Association. They are also at liberty to consult the Secretary in regard to any question which they do not understand, or upon which they are unable to obtain any satisfactory information by the means at their disposal.

All the answers received from the members of the regular class are carefully examined by the Secretary, and to each of such members is sent a criticism of his work based upon this examination. Each member receives also a set of the answers prepared by the Trustees to the questions. Both the criticisms upon the answers of the students to any set of questions and the Trustees' answers to these questions are sent out with the next set of questions.

The number of members in each section at the beginning of the year and the changes that have taken place during the year are shown in detail on the Secretary's Report which is appended. The Second Section now contains 22 members, the Third 30 and the Fourth 36, making the total membership in the regular class

88. There are two special students who are receiving the questions and answers with the Fourth Section.

The other branches of the work as described in previous reports have also been kept up.

The Treasurer's Report, which is appended, shows the total amount of subscriptions to date, the available income and expenses for the year, a summary of the cash account and a statement of the amount of the surplus fund and the securities in which it has been invested.

This surplus fund is made up of portions of subscriptions paid in in advance of the time when they are due, of unexpended balances and of interest received on investments. The proper proportion of the advance subscriptions will of course be drawn out each year to meet expenses, but the unexpended balances and the interest will accumulate into a fund which will be available to assist in carrying on the work in case all the present subscriptions are not renewed when they expire.

Respectfully submitted,
Trustees Gas Educational Fund,
WALTON CLARK,
Chairman.
ALFRED E. FORSTALL,
Secretary.

SECRETARY'S REPORT, SEPTEMBER 30, 1901.

		Second Section.		Third Section.		Fourth Section.	Special Section.	Total.
Members enrolled October 1, 1900....		42		53				95
Entered Class January 1, 1901.......				1		32	1	34
Additions to Class since January 1....				1		25	1	27
		42		55		57	2	156
Resigned since October 1, 1900..	7		7					
Resigned since January 1, 1901...					6			
Dropped for non-receipt of answers to date......................	13	20	18	25	15	21		66
Total enrollment this date.......		22		30		36	2	90

	Third Section.	Fourth Section.	Fifth Section.	Total.
Applications on file for admission to Class January 1, 1902....................	1	2	5	8

STATEMENT OF EUGENE VANDERPOOL, TREASURER, SEPTEMBER 30, 1901.

Condition of Subscriptions.

		Per Year.
Total amount of Subscriptions, October 1, 1900	$20,979 20	$4,196 84
New Subscriptions received since that date	125 00	25 00
Total to September 30, 1901	$21,104 20	$4,221 84
Less amount discontinued and unpaid and not considered good	105 00	30 00
Total available to September 30, 1901	$20.999 20	$4,191 84
Received from Subscribers during year...	$3,712 00	
Advance payments not applicable to year	120 00	
Total paid in by Subscribers available for this year	$3,592 00	
Paid in previous to current year on account of 1901 subscriptions	598 84	
Still unpaid, but considered good	1 00	
Total amount of subscriptions available for this year		$4,191 84
Dues received for Membership in Special Section		10 00
Total amount available for this year,		$4,201 84

Statement of Income and Expense for Year.

Total amount available for year		$4,201 84
Expenses.		
Secretary's Salary	$3,000 00	
Office Rent	300 00	
Furniture (Filing Cases)	36 44	
Printing, Stationery, Postage, etc.	457 48	
Cuts for Illustrating Answers	64 21	
Total Expenses		$3,858 13
Balance		$343 71

Cash Account for Year.

Receipts.

Received from Subscribers during year	$3,712 00	
Interest for one year on $2,000 Binghamton Gas Works 1st Mtg. 5% Bonds	100 00	
Interest for one year on $1,500 Atchison, Topeka & Santa Fé R.R. General Mtg. 4% Bonds	60 00	
Dues received for Membership in Special Section of Class	10 00	
Cash Balance from last year	209 06	
Total amount paid in		$4,091 06

Expenditures.

Total Expenses		$3,858 13
Balance		$232 93
Net balance in National Newark Banking Company, as per Pass Book, less checks unpaid	$227 93	
Cash on hand	5 00	
Total		$232 93

Surplus Fund and Investments.

Amounts paid in in advance		$1,365 56
Unexpended balance from 1898–99		1,330 99
Interest paid on Bonds to date		239 72
Unexpended balance from 1899–1900		397 70
Total		$3,333 97

Already Invested.

$2,000 Binghamton Gas Works 1st Mtg. 5% Bonds	$1,930 00	
$1,500 Atchison, Topeka & Santa Fé R.R General Mortgage 4% Bonds	1,513 75	
Total		$3,443 75

NEW YORK, October 11, 1901.

This is to certify that we, the Finance Committee, have examined the books and vouchers of Eugene Vanderpool, Treasurer, and find that the same are correctly stated and balanced, and that there is due from him in cash the sum of two hundred and thirty-two dollars and ninety-three cents.

ALEX. C. HUMPHREYS,
W. F. DOUTHIRT,
Finance Committee.

APPENDIX TO REPORT OF THE TRUSTEES GAS EDUCATIONAL FUND.

FOURTH SERIES OF QUESTIONS, 1900—SECOND SECTION—PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

1. What is meant by the term "bond" as used in speaking of brick-work? What is English Bond? What is Flemish Bond? Give sketches as well as descriptions.
2. Describe, with sketches, a full set of retort house firing and cleaning tools. Do not include in your answer tools for repairing, or coal and coke wagons.
5. Describe briefly and generally some system of charging retorts by steam or hydraulic machinery.
4. Describe some form of apparatus for separating water-gas tar from its accompanying water, the purpose being to remove all appearance of tar from the works' drainage.
5. What is meant by the statement—"The specific heat of a certain substance is .750, or is three-quarters that of water"?
6. Is the specific heat of a gas, or vapor, at *constant pressure*, that is, when free to expand, as gas in a gas-holder, the same, or more or less, than the specific heat of the same gas or vapor at *constant volume*, that is when confined, as steam in a boiler? Why?
7. An illuminating gas has the following composition by volume:

Carbonic acid	(CO_2)	1.60%
Oxygen	(O)	.39%
Illuminants		4.75%
Carbonic oxide	(CO)	8.04%
Hydrogen	(H)	47.04%
Marsh Gas	(CH_4)	36.02%
Nitrogen	(N)	2.16%

Calculate the heating power per cubic foot, assuming the illuminants to be Olefiant Gas (C_2H_4) and the water formed by the combustion of the hydrogen and hydrocarbons to pass off as vapor at a temperature of 212° F.

8. Describe the testing of a consumer's meter. Give all the precautions to be observed.

9. If you were sent to a house to investigate a complaint of "poor gas" how would you proceed to determine the cause of the trouble?

10. Name some useful purpose, or purposes, to which tar (coal-gas or water-gas) can be applied around gas works, and describe the method of preparation and employment for such purpose.

11. Describe two methods employed for "venting" oil storage tanks so as to permit the escape, when the tanks are being filled with oil, of the vapor that has accumulated in them and to prevent the formation of a vacuum while the oil is being pumped out, and state their respective advantages and disadvantages.

12. What is naphthalene? What are its physical properties, and how are the obstructions caused by it removed?

(Answer to these questions are due December 5th.)

Fourth Series of Questions, 1900—Third Section—Practical Class—American Gas Light Association.

1. What size of anthracite coal is best suited for use as the fuel in the generator of a carburetted water-gas apparatus? Give the reasons for your answer.

2. Describe the putting into operation of a bench of retorts heated by a generator furnace, from the lighting of the fire

to the putting in of the first charge; giving the precautions to be taken to prevent any injury to the setting.

3. Describe, with sketches, one or more forms of the condensers used for cooling illuminating gas during the process of manufacture.

4. Should the speed of an exhauster used for the purpose of relieving the retorts of a coal gas plant from the pressure thrown by the rest of the apparatus be governed in the same way as the speed of an exhauster used for drawing gas from the relief holder of a carburetted water-gas plant and forcing it through the rest of the apparatus? Give the reasons for your answer.

5. What is meant by a "unit of heat" or "heat unit"? What is the difference between quantity of heat and intensity of heat?

6. A gas with a specific gravity of .750 is carried by a street main over a hill 85 feet high. The gas is at rest for the time. The pressure in the pipe as shown by a syphon gauge at the foot of the hill is $\frac{15}{16}''$. What will be the pressure shown by a gauge attached to the pipe at the top of the hill? Give your calculations.

7. In the answer to question No 7, Third Series, 1900, the yield of ammoniacal liquor per ton of coal is given as 30 gallons of from 8 to 10 oz. (4° to 5° Twaddell) strength. What is the meaning of a degree Twaddell and of ounce when used in this connection.

8. Describe,—with sketch of a longitudinal section of both spigot and hub showing outside diameter of spigot, all dimensions of the hub or bell, the shape of the lead groove in the bell, and the depth and finished shape of the lead,—the making of a lead joint in a 6 inch cast iron main. Give also the amount of lead and packing used and the length of time that should be required to do the work.

9. What is a Holophane Globe and how does it affect the useful light given by the source of light over which it is used?

10. In setting a gas range which has an oven burner and four top burners what size of pipe should be used, and to what size meter should it be connected?

11. What are the rules by which to determine the proper size of house piping to be used, when the number of lights to be supplied and the length of pipe along which they are to be placed are known?

12. Describe the preparation and use of cement mortar for brick work construction, with the precautions to be observed to insure strength and uniformity.

(Answers to these questions are due December 1st.)

ANSWERS TO FOURTH SERIES OF QUESTIONS, 1900—SECOND SECTION—PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

Answers to all these questions, except Nos. 1, 3, 7, 9, 11, and 12 have been published in previous volumes of the Proceedings, and can be found there, as follows:

No. 2, Vol. XV, page 42.
No. 4, Vol. XV, page 69.
No. 5, Vol. XV, page 30.
No. 6, Vol. XV, page 48.
No. 8, Vol. XV, page 65.
No. 10, Vol XV, page 52.

The answers to Questions Nos. 1, 3, 7, 9, 11, and 12, are as follows:

1. What is meant by the term "bond" as used in speaking of brick work? What is English bond? What is Flemish bond? Give sketches as well as descriptions.

Ans. "Bond" in brick work denotes the uniform system in accordance with which the bricks are placed in the wall.

English bond is a system in which all the bricks in any one course are either headers (bricks laid with their length perpendicular to the face of the wall), or stretchers (bricks laid with their length parallel to the face of the wall). Sometimes the courses of headers and stretchers alternate, but usually there are several courses of stretchers for each course of headers. In ordinary walls the proportion of stretcher courses to header courses is sometimes made as high as seven to one, but this makes a wall which is weak transversely, since stretchers give longitudinal strength and headers transverse strength. For the walls of gas works buildings, at least one course in four should be laid in headers. One course of headers in three courses gives equal strength longitudinally and transversely.

In laying bricks in English bond, care must be taken to make the vertical joints in the header courses thin, so that the two headers and the vertical joint between them will not take up a greater length than the stretcher, and prevent the correct breaking of the joints by one-quarter of a brick.

Flemish bond is a system in which the bricks in each course are alternately headers and stretchers, the outer end of each header lying on the middle of a stretcher in the course below. There are the same number of vertical joints in each course and there is, therefore, nothing to prevent the proper breaking of these joints. Brick work laid in Flemish bond presents a neater appearance than does that laid in English bond, but the latter is stronger than the former. (Trustees.)

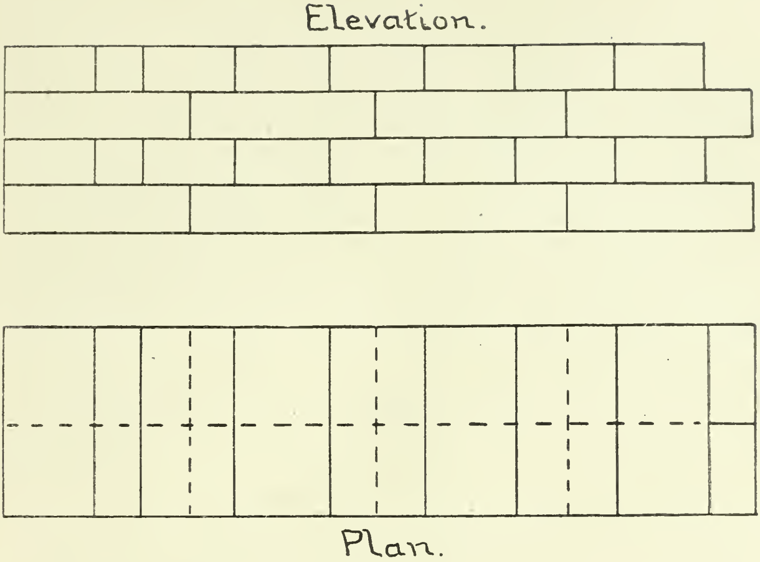
3. Describe briefly and generally some system of charging retorts by steam or hydraulic machinery.

Ans. So far no system of machinery for charging coal gas retorts, worked by either steam or hydraulic power, has proved perfectly successful in this country. The charging machine described below has, however, been adopted to a certain extent in some large gas works and seems to be moderately successful.

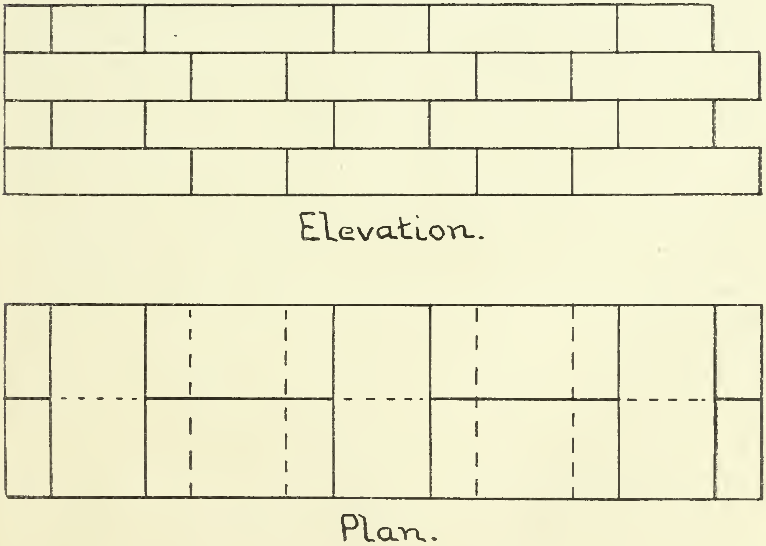
It consists of a carriage or platform mounted on wheels, running on a track laid on the charging floor of the retort house, in front of, and parallel to, the face of the retort stack. This platform carries a steam boiler, a coal hopper, a track at right angles to the main track, upon which run the wheels of a second carriage called the scoop carriage, and two steam engines, one for the purpose of moving the main carriage back and forth along the track on the floor, and the other for moving the scoop carriage and the scoops attached to it, back and forth in a direction at right angles with the front of the stack.

Motion is communicated to the main carriage by means of an endless screw on the shaft of the engine, and a worm gear on one of the axles of the carriage. The engine is provided with reversing gear and also with a brake on its shaft for the purpose of slowing down and stopping the carriage.

The scoop carriage is driven by a chain or wire rope running around, and driven by a drum mounted on the main carriage.



English Bond.



Flemish Bond.

After winding round the drum, one end of the rope is led to, and around a pulley fixed at the front of the main carriage, and then brought back and fastened to the scoop carriage. The other end of the rope is similarly treated, except that the pulley around which it is led is fastened to the back of the main carriage. The drum itself is driven by the corresponding engine through an endless screw and worm gear. The engine is fitted with a reversing gear to which a tappet bar is connected so that the engine is automatically stopped when the scoop carriage reaches the end of its travel in either direction.

The scoop carriage is provided with shelves or brackets for supporting the scoops, there being one for each scoop. There are usually three such scoops arranged vertically, one over the other, at such a distance apart that each comes opposite the corresponding retort in the setting. Under each of the scoop supports are fixed two rollers, the tops of which protrude through openings in the supports, so that the bottom of the scoop rests upon them. Each scoop consists of a long box, or trough, built of steel and open at the top and front end. Resting loosely in the scoop and on its upper edges is a frame with angle iron sides and cross-braces, which carries a series of scrapers. All of these scrapers, except the one nearest the back end of the scoop, are so fastened to the frame by pivots that their lower edges will swing forwards and upwards so as to allow them to pass freely over any coal in the scoop or retort when being drawn backwards, while they strike and rest firmly against the bottom of the scoop when being pushed forward. The rear scraper is rigid and forms the back end of the coal space in the scoop.

The scraper frame can be moved back and forth relatively to the scoop through a distance a little longer than that part of the scoop which contains the charge of coal. As the scoop with the coal is being pushed into the retort, and just before it reaches the limit of its travel, the lower end of a lever pivoted on the side of the scoop near the back strikes a stop fixed on the coal hopper, and is pushed backward as the scoop moves on. As its fulcrum on the scoop is moving forward the upper end of the lever is given a forward motion, more rapid than that of the scoop, and since it rests against the back of the scraper frame this is pushed forward faster than the scoop, and the scrapers push the coal ahead of them and partly out of the scoop into the seat of the retort, this action taking place just before the scoop reaches the end of its travel and stops. When the scraper frame arrives at its extreme forward position, a pawl, pivoted on the main carriage, drops behind the rear cross-bars of the frame, and this with the scrapers is thus held stationary, while the scoop is being withdrawn from the retort. By this means the coal is held in place and drops on to the bottom of the retort as the scoop recedes, instead of being drawn backward with it. When the scoop has been entirely withdrawn from the retort a trip piece on its side strikes an angular tappet piece so pivoted that as its lower end is moved back by the trip piece its upper end raises the pawl and leaves the scraper frame free to move back. The mechanism which imparts the backward motion to the frame is contained in the back part of the scoop behind the coal space, and consists of a bar, a forward pulley fastened to the scraper frame, a rear pulley fastened to the scoop, and a rope which is fastened at one end to the rear of the scoop, passes forward around the pulley on the frame, back around the pulley fixed to the scoop and forward to have the other end fastened to the bar. This bar is free to slide back and forth in guides in the scoop. So long as the scoop and scrapers are traveling together this mechanism travels as a whole with them. When the scoop moves back, while the scraper frame is held stationary, the end of the rope fastened to the scoop and the pulley also fastened to the scoop, move away from the pulley fastened to the frame. To accommodate this motion, that portion of the rope passing around the pulley fixed to the frame must lengthen on each side of the pulley by an amount equal to the distance traveled by the scoop. This extra length can only be obtained by drawing on that part of the rope passing forward from the rear pulley on the scoop and fastened to the bar, which, since the bar is free to move is practically a free end. The bar, therefore, is given a backward motion (in the same direction as the scoop) twice as fast as that of the scoop. This continues until the detaining pawl has been lifted, as described above. The continued movement of the scoop then immediately brings the end of the bar against a stop fastened on the main carriage, against which the rear end of the scoop also rests when it is at the extreme back end of its travel. The motion of the scoop still continues, but that of the bar being arrested, the end of the rope fastened to it is no longer a free end, and as the scoop moves back the rope is thus held at one end while the other end, which is attached to the scoop, is drawn backward as is also the loop passing around the pulley fastened to the scoop. The only part that is free to move to furnish the slack required to accommodate this double motion is the pulley fixed to the scraper frame, and this is accordingly drawn back bringing with it the frame and scrapers at a rate of motion twice as fast as that of the scoop. The mechanism is so adjusted that when the scoop stops at the end of its travel the scrapers have reached their original position and everything is ready for another charge.

Both the scoop and the scraper frame are weighted at the rear end, the weight on the scoop serving to indicate when the proper weight of coal for the charge has been run into the scoop, and that on the frame acting as a counterweight to balance the portion which is left projecting into the retort as the scoop is withdrawn.

Either one, two or all three of the scoops can be locked either to the scoop carriage or to the main carriage. The scoops which are locked to the main carriage remain stationary when the others are run into the retorts, and in this case the rollers fixed to the scoop carriage, and on which the scoops rest, come into play to reduce the friction between the stationary scoop and the moving carriage.

The boiler and engines do not require any detailed description.

The coal hopper is divided into three equal compartments, each having a longitudinal opening the full length of the coal space of the scoop, and in such a position vertically as to allow the coal to be fed through it by a feeding device into the corresponding scoop. It is intended that it should be made large enough to hold all the coal required for the retorts to be charged at any one time.

The operation of the machine is as follows:

Two attendants are required; one to handle the traversing engine and the other to attend to the actual charging. When the machine is placed in front of the proper retorts the scoops are filled until the weight of the coal causes the front part to just balance the weight at the rear end, the forward rollers of the two under each scoop acting as fulcrums The scoop carriage engine is then started forward and the motion of the carriage carries the scoops attached to it into the retorts. Just before this forward motion is automatically arrested when the front ends of the scoops have reached nearly to the back ends of the retorts the accelerated forward motion is imparted to the scrapers so that the coal is pushed into the seat of the retort. As the engine stops and the carriage is brought to rest the detaining pawls drop and hold the scraper frames. The engine, which has stopped automatically, is then reversed by the attendant and the scoops withdrawn from the retorts, leaving the coal, which is held in place by the scrapers. The front ends of the scoops being lightened by the removal of the coal, are raised by the lowering of the counter-balance weights at the rear end and carry with them the scraper frame, raising the scrapers nearly clear of the coal. The continued backward travel of the scoops raises the detaining pawls, brings the bar of the scraper-withdrawing mechanism against the stop and then withdraws the scrapers, the engine being stopped automatically when everything is in its original condition at the back end of the travel of the scoop carriage. The main carriage is then moved opposite the next tier of retorts and the operation repeated, the process being continued until all the retorts have been charged.

For descriptions of other charging machines see Journal of Gas Lighting, Vol. LXIII, page 957, and American Gas Light Journal, Vol. XLIX, page 345. (Trustees.)

7. An illuminating gas has the following composition by volume:

Carbonic Acid	(CO_2)	1.60%
Oxygen	(O)	.39%
Illuminants		4.75%
Carbonic Oxide	(CO)	8.04%
Hydrogen	(H)	47.04%
Marsh Gas	(CH_4)	36.02%
Nitrogen	(N)	2.16%

Calculate the heating power per cubic foot, assuming the illuminants to be Olefiant Gas (C_2H_4), and the water formed by the combustion of the hydrogen and hydrocarbons to pass off as vapor at a temperature of 212° F.

Ans. The heating power per cubic foot of an illuminating gas can be obtained, when its composition by volume is known, by multiplying the heating power per cubic foot of each of the combustible constituents of the gas by the volume of such constituents contained in a cubic foot, as shown by the analysis, and then adding together the products of these multiplications, the sum obtained by this addition being the required heating power per cubic foot.

The statement of the problem shows that the illuminants are to be considered as being Olefiant Gas (C_2H_4), and that the net heating power of the gas is desired and not its gross heating power, the distinction between net and gross heating power having been explained in the circular accompanying the answers to the second series of questions for 1900. (See Proceedings, Vol. XVII, page 108.)

In this circular the net heating power per pound of Hydrogen (H) under the conditions assumed in the present problem was given as 53,406 heat units. Since the complete combustion of a pound of Marsh Gas (CH_4) produces 2.25 lbs. of water the net heating power per lb. with this water in a state of vapor at 212° F., will be 21,462.5 heat units, this value being determined by a calculation similar to that made for hydrogen in the circular mentioned. In the same way it is found that Olefiant Gas (C_2H_4), the complete combustion of 1 lb. of which produces 1.285 lbs. of water, has a net heating power of 20,656.7 heat units per pound. The product of combustion of Carbonic Oxide (CO), Carbonic Acid (CO_2), is gaseous at ordinary temperatures and no deduction has to be made from its gross heating power.

The heating powers per cubic foot which enter into the problem are therefore as follows:

Illuminants: 20,656.7 (net heating power per pound) divided by 13.506 (number of cubic feet in a pound) = 1,529 heat units,

Carbonic Oxide (CO) from answer to Question No. 6, Second Series, 325 heat Units,

Hydrogen (H) 53,406 (net heating power per pound) divided by 189.09 (number of cubic feet in a pound) = 282 heat units,

Marsh Gas (CH_4) 21,462.5 (net heating power per pound) divided by 23.636 (number of cubic feet in a pound) = 908 heat units,

and the heating power per cubic foot of the illuminating gas, of which the analysis is given, is equal to $(1{,}529 \times .0475) + (325 \times .0804) + (282 \times .4704) + (908 \times .3602) = 72.62 + 26.13 + 132.65 + 327.06 = 558$ heat units.

The gross heating power of this gas as determined by a calorimeter would be theoretically 623 heat units per cubic foot.

It is interesting to note that of the total net or available heating power of the gas there is derived, in round numbers, 13% from the illuminants, 5% from the carbonic oxide, 24% from the hydrogen and 58% from the marsh gas (Trustees.)

9. If you were sent to a house to investigate a complaint of "poor gas" how would you proceed to determine the cause of the trouble?

Ans. It is assumed in this answer that it is known that the main in the street and the service into the house are both of sufficient size to insure a proper pressure at the head of the service at all times if there is no stoppage in the service, that the house-piping is of the proper size, and that the burners are in good order.

First determine, either by inquiry from the consumer or by investigation, the nature and location of the trouble. If it is general, that is occurs all over the house, the cause must be sought in the service, meter, or the riser between the meter and the first branch pipe. If it is confined to one floor, or one room, it is only necessary to examine the portion of the system which supplies that floor or room.

Poorness of light due to a uniform low pressure without fluctuation indicates the existence at some point of an obstruction formed by solid matter. A quick sharp jumping of the flame shows an accumulation of liquid at some point, and a slow rise and fall in the size of the flames which takes place at comparatively long and regular intervals is a sign that the meter is overloaded or else sticks at some point.

If intelligent information as to the above points can be obtained from any of the inmates of the house the procedure can be governed accordingly. If this information cannot be had it will be necessary to secure it by lighting burners in various parts of the house, and in sufficient number to test the steadiness of the delivery of the meter, and then determining from observation of the flames the probable cause of the trouble.

If the trouble is located on a particular floor or in a particular room, examine and clean the burner keys and the bracket swings, and if this does not remedy it explain to the consumer just where you think the stoppage is located and tell him to call in a plumber and have it removed, but do not take off the chandeliers or brackets.

If the trouble is general and seems due to an obstruction of solid matter, take out the plug in the tee where the service comes through the cellar wall and determine whether the service is clear, either by observing the amount in, and the force with, which the gas escapes through the open end of the tee, or else by blowing into the service with the lungs. If it is found not to be clear, try to clear it by the use of a wire and an air pump, or by the use of gasolene or naphtha followed by the pump.

If the service is clear, examine the inlet connection of the meter, and then if necessary the outlet connection, being particularly careful to see that these connections have not been flattened in any place so as to shut off the flow of gas.

When an accumulation of liquid at some point is suspected test the service as above. The presence of water can be readily detected by the intermittent flow of gas, as well as by the gurgling noise made by the gas as it bubbles through the water. If water is found blow it out with the pump. If the service is clear take out the meter drip plugs to see if any water has condensed and lodged in the meter drips.

Test the meter also by leaving it connected on the inlet and taking off the outlet connection so as to allow the gas a free passage through it, and note the rate and the steadiness with which it flows. This meter test should also be made where an obstruction of solid matter is suspected but cannot be located in the service or the meter connections.

A general trouble that cannot be found in either the service, meter, or meter connections must be in the house piping and if the stoppage cannot be removed by running a wire up the main riser or by blowing out the exposed pipes in the cellar, locate it as closely as possible, tell the consumer where you believe it to be and advise him to call in a plumber to clean it out. If water is found in the service, notice should be given to the main-laying department so that the service can be taken up and relaid to a proper grade. (Trustees.)

11. Describe two methods employed for "venting" oil storage tanks so as to permit the escape, when the tanks are being filled with oil, of the vapor that has accumulated in them and to prevent the formation of a vacuum while the oil is being pumped out, and state their respective advantages and disadvantages.

Ans. One method employed for venting oil storage tanks at gas works is to connect the vent pipe either to the gas-holder inlet or outlet, or to some part of the pipe system around the works, such as the foul main.

Another method is to have either a single vent pipe, which branches into two outlets opening into the air, or else to have two vent pipes, and to place a pressure relief valve on one outlet and a vacuum relief valve on the other outlet, being careful to keep the open ends of each pipe covered with brass wire gauze of not less than say 2,500 meshes to the square inch.

The great advantage of the first method is that it entirely prevents the formation of an explosive mixture of air and oil vapor in the top of the tank, since as oil is withdrawn from the tank its place is taken by gas from the holder or pipe system. The disadvantage, which is greatest when napththa is used and stored in an uncovered tank exposed to the sun's rays, and when the vent pipe is connected directly to the holder outlet or to a pipe to which consumers' services are also connected, is that at times, when the tank is being filled with oil and when the weather is hot, an excessive amount of vapor passes over into the gas being supplied through this pipe and causes it to smoke badly when consumed. This disadvantage is of smaller importance when the tank is roofed over or covered with water, and when heavy oil is used and the vent pipe can be connected into the foul main it practically disappears, and under these circumstances this method of venting is the best possible one.

The second method obviates any such interference with the regulation of the quality of the gas as may result, as stated above, from the first method, but has the great disadvantage of permitting the formation of a mixture of air and oil vapor in the top of the tank, which mixture may be fired and cause more or less damage. It is, however, thought by some good authorities to be preferable to the first method when naphtha is used and stored in tanks exposed to the sun, owing to the trouble experienced under these conditions from the tendency of the vapor-laden gas to smoke. The caps of fine wire gauze placed over the vent pipes should prevent any flame from striking back into the tank even in case the vapor escaping from the pipes should be accidentally fired. Of course, in normal working no naked light should ever be allowed near an oil tank under any circumstances. (Trustees.)

12. What is naphthalene? What are its physical properties, and how are the obstructions caused by it removed?

Ans. Naphthalene is a hydrocarbon formed in comparatively small quantity (about 13.15 lbs. per ton of ordinary English coal distilled in coal-gas retorts, according to Mr. R. W. Irwin) during the distillation at high temperatures of carbonaceous substances such as coal and petroleum. It has been claimed that naphthalene can be formed in the gas after it leaves the retorts and during distribution, but this view is generally held to be incorrect, and from the present knowledge of the subject it seems practically certain that all the naphthalene found either in coal gas or coal tar is produced during the distillation of the coal in the retorts. The molecule of naphthalene is composed of 10 atoms of carbon and 8 atoms of hydrogen, its chemical symbol being $C_{10}H_8$.

It is a solid at ordinary temperatures and pressures, melts at a temperature of 176° F. and boils at about 430° F. It will, however, exist in a state of vapor suspended in gas at temperatures far below even that at which it solidifies as long as the gas is not saturated with it. As soon as the point of saturation is reached the vapor passes directly into the solid state in the form of very light, flaky, flat crystals which occupy a large volume in proportion to their weight. It is this property which renders naphthalene so troublesome to the gas manufacturer, since though the weight contained in a given quantity of gas is small (about .15 lb. per 10,000 cubic feet of ordinary English coal gas, according to Mr. R. W. Irwin) the crystals occupy sufficient space to seriously obstruct the apparatus and pipes around the works and the services in which they are deposited through chilling of the gas.

Naphthalene obstructions in the apparatus and pipes at the works are usually removed either by flushing with hot water or by steaming, the former being preferable since the steam merely melts the naphthalene, and unless it can escape from the pipe at once it may cool down again and solidify in another part of the apparatus, while the hot water acts not only by melting the naphthalene but also by carrying it along, to a certain extent, in mechanical suspension. It is well to use the water in considerable volume in order to secure this latter effect.

Naphthalene is removed from service pipes and small mains by means of light naphtha, gasolene or kerosene, which is poured into and allowed to run through the pipes, dissolving the crystals and carrying the naphthalene in a liquid form back into the mains and the drips. Sometimes wood alcohol is used instead of naphtha or kerosene. If the obstruction is very light it may be blown out of the service into the main by means of an air pump, or even by the lungs

Naphthalene in the form of crystals, like water in the form of ice or snow, will pass from the solid state directly into that of vapor, and thus naphthalene that has been deposited in the pipes in quantities too small to cause trouble and render it necessary to clean it away will evaporate again and pass off with the gas when this reaches the deposit in an unsaturated condition. This same naphthalene may be re-deposited farther along in the system if the temperature changes so as to bring the gas again to the point of saturation with naphthalene, and it is probable that some action of this kind has given rise to the theory that naphthalene can be formed during distribution in a gas which was free from it when it left the holders. (Trustees.)

ANSWERS TO FOURTH SERIES OF QUESTIONS, 1900—THIRD SECTION—PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

The answer to question No. 12 has been published in Vol. XV of the Proceedings, page 24, and can be found there. The answers to the other questions are as follows:

1. What size of anthracite coal is best suited for use as the fuel in the generator of a carburetted water gas apparatus? Give the reasons for your answer.

Ans. The sizes of anthracite coal that are usually considered available for use as the fuel in the generator of a carburetted water-gas apparatus are:

Steamboat, consisting of pieces which pass through a screen in which the bars are set from 4″ to 7″ apart, the smaller sizes of coal having previously been screened out.

Broken, consisting of pieces which fall through a screen with a 4″ mesh but pass over one with a 2½″ to 2¾″ mesh; and

Egg, consisting of the pieces which fall through a screen of 2¼″ to 2¾″ mesh but pass over one with a 1½″ to 1⅞″ mesh.

Of these sizes, that known as broken has been found to give the best results for general use, though in very large generators, those over 8 feet in diameter, the steamboat size might be better.

The advantages possessed by broken coal are, that the lumps are sufficiently large to maintain the bulk of the fire in an open state which affords a ready passage to the air in blasting and the steam when making gas, and yet are small enough to present a large surface of carbon to be acted upon by the oxygen, and it is thus possible to secure the proper combination of the greater portion of both oxygen and carbon in each case. Smaller coal affords a larger total surface, but at the same time forms a large compact mass in the center of the generator, through which the air and steam cannot pass readily. They therefore pass only through that portion of the area of the generator which lies between the outside wall and this compact mass in the center. The larger size affords a freer fire but much less total surface, and has moreover the disadvantage of being hard to handle in mechanical conveyors.

In a paper on the "Selection of Anthracites for Water Gas," read before the American Gas Light Association, October 20, 1892, Mr. C. R. Collins states that the inactive portion of the fire which is due to the compacting of the coal in the centre of the generator where the lumps can fit into each other more perfectly than they can in the space next the walls, "varies with the diameter (of the generator) and with the size of the coal; thus in a particular generator, egg coal renders about 30% of the fire partially inactive, the bulk of the work being done in the outer parts representing 70% of the fuel; in the same way broken coal affects about 15% of the fuel bed, while steamboat coal leaves a practically free fire." He also states that steamboat coal presents approximately 7 square feet of surface for each cubic foot of generator space; broken coal 10 square feet of surface per cubic foot of space, and egg coal 22 square feet of surface per cubic foot of space. These figures are for selected coal of the standard size in each case. In practice the steamboat coal will have some broken coal in it, the broken some egg, and so on, and the presence of this smaller coal will increase the size of the inactive portion of the fire as well as the amount of surface presented to the air and steam. It is therefore important that no matter what size is being used the smaller pieces and slack should be screened out and not used in the generator, the coal used being kept as near the selected standard size as possible.

The members of the class should read Mr. Collins' paper which can be found in the Proceedings of the American Gas Light Association, volume 10, page 82; in the American Gas Light Journal, volume 57, page 690; and in Progressive Age, volume 10, page 399. (Trustees.)

2. Describe the putting into operation of a bench of retorts heated by a generator furnace, from the lighting of the fire to the putting in of the first charge; giving the precautions to be taken to prevent any injury to the setting.

Ans. The method to be employed in putting into operation a bench of retorts heated by a generator furnace will depend somewhat upon whether the bench has just been built or reset, or is one that has been previously fired up and let down.

In the case of a new bench, or of one that has just been reset, it is necessary that all the brick work about the bench should be thoroughly dried by being subjected to a low heat for a long time before any attempt is made to heat it up to a working point. This drying cannot be hurried without injury to the bench, and at least two weeks should be allowed for it. It is effected by keeping a very low fire on the grate of the furnace, using about a bushel of coke at the start and keeping the fire about the same size afterwards. The clinkering door of the furnace should be left wide open, the object being to pass through the bench as much moderately warm air as possible so as to pick up and carry off the moisture. The primary and secondary air ports should be closed, and also the main dampers. When the fire is first made all the stoppers in the front wall of the setting should be removed, leaving the stopper holes open. An opening the size of one or two bricks header wise should also have been left in this wall directly under the crown of the arch. As the main dampers are closed the warm air laden with the moisture picked up in the furnace and lower part of the setting escapes through these openings in the front wall carrying the moisture with it, while if it had to pass all around the retorts and through the take-off flues it would become cool and deposit most of the moisture in these flues before it escaped to the chimney. After the furnace is dried the stoppers can be put in the lower openings and the warm air forced to travel farther along, and so on, until after a week or ten days the main dampers can be opened a little, the large opening under the crown of the arch closed up and the warm and now comparatively dry air drawn through the whole of the setting and the take-off flues, thus drying all portions of the bench.

After the drying out is completed the bench is brought up to working heat in exactly the same manner as a bench that has been let down after a certain amount of service, except that a new bench should be heated up a little more slowly than an old one.

For heating up a slightly larger fire is built than is used for drying out. Either just before or immediately after this fire is started any coke left in the retorts from previous working must be drawn, the retort mouth-pieces closed, the secondary air ports closed, and all stopper openings and cracks in the brick work carefully plastered up so that no air can get into the bench except through the primary air flues and the clinkering door. The primary air ports are opened slightly, as are also the main dampers. The clinkering door instead of being left wide open, as in drying out, is only left slightly ajar, since now the object is to have the fire heat the bench and not to have it heat an excess of air passing through the bench. It is necessary to leave the door open a little to admit air above the surface of the fire for the purpose of consuming any carbonic oxide (CO) that may be formed, as soon as it escapes from the fuel and thus prevent the formation of an explosive mixture of CO and air in the upper part of the furnace and in the setting, since such a mixture if allowed to form would probably be ignited later and explode with more or less damage to the bench. It is also necessary that the surface of the fire should never be entirely covered with cold coke, some portion being always left hot and incandescent to ignite the CO as soon as it meets the air.

The fire is gradually increased until at the end of from 48 to 96 hours it can no longer be fed through the clinkering door. The plates and water pan of the step grate are now put in, the clinkering door shut, the water started running on the grate, and the primary air ports and main dampers opened wider. The fire is fed through the filling door until the furnace is half full. If cold coke is used the precaution noted above of never entirely covering the hot surface of the fire must be carefully observed. If hot coke is used, this, of course, obviates any danger of a cold surface to the fire. As soon as the combustion chamber and lower retorts reach a good red heat and the CO coming from the furnace is seen to burn at the nostrils when air is admitted to the combustion chamber, the secondary air can be turned on and the bench brought up to heat as rapidly as is necessary, the furnace still being kept about half full of coke, being completely filled only a few hours before the bench is to be put in action.

As soon as the retorts reach a red heat they should be patched and charged with coal, the charges being left in until burnt out. The bridge pipe covers should, of course, be closed before the retorts are charged. When the bench is nearly up to its proper working heat regular charging can begin, and when this heat is reached the openings of dampers and primary and secondary air ports must be carefully regulated to the proper respective areas.

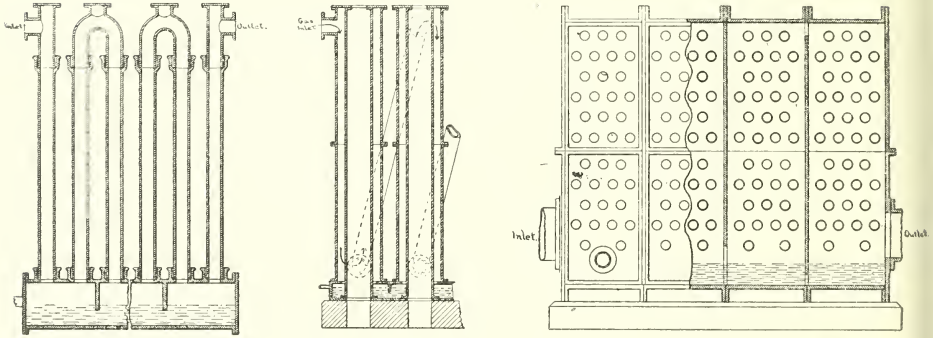
If necessary, an old bench can be put in action within sixty hours after the fire is first started, but it is best to proceed more slowly if possible and spend five or six days in bringing the heat to the working point. (Trustees.)

3. Describe, with sketches, one or more forms of condensers used for cooling illuminating gas during the process of manufacture.

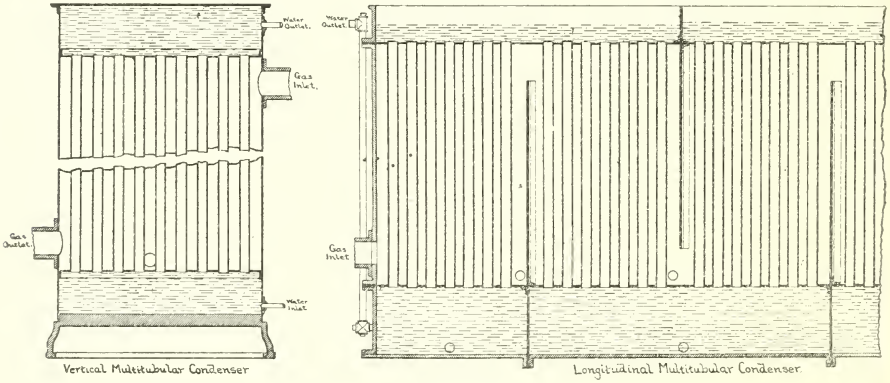
Ans. One of the earliest and simplest forms of condensers used for cooling illuminating gas during the process of manufacture is composed of ordinary cast-iron pipes inclined at a small angle to the horizontal and fastened to the side of a wall in such a way that the pipes zigzag back and forth until the ground line is reached. The gas passes through these pipes and radiates its heat into the air until it is cooled down to the temperature of the atmosphere. This form has been elaborated into what is known as the flat screw condenser, in which the inclined pipes are in double tiers and are mounted on frames or standards.

Another simple form of atmospheric condenser is composed of vertical pipes mounted on a cast-iron box. The pipes are connected together at the top, in pairs, by return bends provided with cleaning holes, and in the box, partitions sealed in the liquids condensed from the gas, are placed between the pipes joined together by the bends; there being one partition for each pair of pipes. The box is thus divided into compartments into each of which two pipes, which are not connected together at the top, open. At each end is a single pipe opening into a compartment of the box, into which also opens one pipe of a set of two connected at the top. By this arrangement the gas entering at the top of the single pipe at one end passes down into the box and then up and down the pipes alternately until it passes out at the top of the single pipe at the other end of the apparatus. This condenser has also been elaborated from the simple form containing only a single row of pipes into a condenser containing several parallel rows, the top connection between the pipes being made by properly placed hoods sealed in liquor, the box and partitions at the bottom being substantially the same as in the simple form.

Another vertical atmospheric condenser is the annular condenser, which consists of a series of large pipes, through the center of each of which passes a smaller pipe, open to the air at both top and bottom. The gas travels through the annular space between the pipes and imparts its heat to a current of air induced through the center as well as on the outside of the pipe, the radiating surface being thus nearly doubled. The annular space in one pipe is connected to that of the next by a smaller outside pipe, or pipes, which con-



Vertical Atmospheric Condenser. Elements of Annular Condenser. Battery Condenser.



Vertical Multitubular Condenser. Longitudinal Multitubular Condenser.

Condensers.

veys the gas from the top of one space to the bottom of the next, or vice versa, or else this space is divided into two parts by vertical ribs extending almost the whole length of the pipes, so that the gas passes up on one side and down on the other, and the spaces are connected by short pipes running from the bottom of one to the bottom of the next. If the ribs are arranged to make the gas travel first down and then up, the spaces are connected together at the top instead of the bottom.

Still another form of atmospheric condenser is that known as the battery condenser. This is an oblong box from 2′ to 5′ wide, 10′ to 18′ high and of varying length. It is divided internally into compartments by means of partitions leaving openings alternately at the top and bottom so that the gas entering at the bottom of the first compartment is forced to travel up in this and down in the next until it passes out at the bottom of the last compartment. Tubes 2″ in diameter, with both ends open to the air, are run horizontally across the compartments, and the currents of air passing through these tubes assist in cooling the gas. In both the annular and the battery condensers arrangements are made for regulating, in one case the size, and in the other the number, of the openings for the admission of air, in accordance with the temperature of the air and gas at different times.

Atmospheric condensers of one or another of these types are practically the only condensers used in England, but in this country it is considered better practice to employ condensers in which the cooling of the gas is effected by imparting its heat to water. The usual form of such condensers is the ordinary vertical multitubular type. This consists of a cylindrical wrought iron or steel shell from 2′ to 8′ or 10′ in diameter, and from 12′ to 20′ high, closed at the bottom by a cast iron base plate and at the top by a plate of the same material as the shell. It is divided into one gas and two water compartments, by two horizontal tube sheets, one placed from 18″ to 30″ from the top and the other the same distance from the bottom. In these sheets are expanded a number of 2″ tubes which run through the large gas compartment and open into the smaller water compartments at the top and bottom. Water under pressure being run into the bottom compartment rises through the tubes to the top from which it overflows. The hot gas is admitted at the top of the gas compartment and passes down around the tubes and out at the bottom, becoming cooled as it descends. In this way the hot gas comes into contact first with the part of the tubes containing hot water, and then, as it descends, with the parts containing cooler and cooler water, so that the cooling of the gas should take place gradually. It is found, however, that it is a very difficult matter to regulate the water supply in this form of condenser, so as to both cool the gas thoroughly and at the same time prevent the cooling from taking place suddenly in a space extending over not more than one-quarter to one-third the total height of the condenser.

Sometimes in works making over 500,000 cubic feet per day there is used a rectangular, multitubular condenser made not more than 12′ high, 5′ wide, and of a length proportioned to the amount of gas to be handled. The shell of this condenser is made of cast-iron plates, and the long gas compartment is divided by vertical transverse partitions with openings alternately at the top and bottom, so that the gas travelling through it passes alternately up and down. The water compartments are also divided by similar partitions so placed in each compartment that the water travels up the tubes which pass through the spaces in which the course of the gas is downwards, and down the tubes passing through the spaces in which the course of the gas is upwards. The cold water is admitted at the end at which the gas passes out, and the hot water passes out at the end at which the gas enters, gas and water thus travelling always in opposite directions. With such a condenser properly proportioned to the amount of gas to be handled, the cooling of the gas can be effected very gradually and the difference in temperature of the gas and water at any given point need not exceed 5° Fahr., and by care can be kept still lower. The first cost of the apparatus is, however, greater than that of vertical condensers rated at the same capacity.

Both of these forms of multitubular condensers are also modified by making the gas pass through the tubes which are then surrounded by the water.

All of the types of condensers described must, of course, be furnished with suitable overflow connections for the condensed liquids, and every condenser should be equipped with two thermometers for ascertaining the temperature of the gas, one at the inlet and one at the outlet, in addition to which water condensers should also be provided with thermometers for determining the temperature of the water as it enters and leaves the apparatus.

In English practice, with atmospheric condensers, 10 square feet of surface, including all exposed pipes from the hydraulic main to the outlet of the condensers, are allowed for each 1,000 cubic feet of gas made per day. In this country 5 square feet of tube surface are allowed in water tube condensers for each 1,000 cubic feet of gas made per day. (Trustees.)

4. Should the speed of an exhauster used for the purpose of relieving the retorts of a coal gas plant from the pressure thrown by the rest of the apparatus be governed in the same way as the speed of an exhauster used for drawing gas from the relief holder of a carburetted water gas plant and forcing it through the rest of the apparatus? Give the reasons for your answer.

Ans. The speed of a coal gas exhauster should not be governed in the same way as that of an exhauster drawing gas from the relief holder of a carburetted water gas plant, since the two exhausters perform entirely different duties.

That of the coal gas exhauster is to relieve the retorts of the pressure thrown by the rest of the apparatus and to maintain a constant low pressure in the hydraulic main. To do this the gas must be drawn away at exactly the rate at which it is being made at any instant, and as the gas is not made at a uniform rate it is impossible for the coal gas exhauster to run at a uniform speed if it is to perform its duty properly. Its speed must therefore be governed in such a way as to be increased as the rate at which the gas is made increases, and to be decreased as the rate at which gas is made decreases. In this way the pressure at the inlet of the exhauster, and consequently in the hydraulic main, is kept constant.

The sole object of the exhauster in a carburetted water gas plant is to force the gas through the purifiers and station meters into the holders, the pressure thrown by the relief holder being, as a rule, insufficient for this work. Since the relief holder compensates for the inequalities in the rate of make, this exhauster can be, and is, run at a uniform speed such that it will handle the gas at a rate equal to the average rate of make, and it must therefore be governed in such a way as to maintain a constant speed, this being varied from time to time to suit the requirements of production. (Trustees.)

5. What is meant by a "unit of heat"? What is the difference between quantity of heat and intensity of heat?

Ans. In order to be able to express various quantities of heat in comparable terms it is necessary to have a standard unit of heat.

The standard, or "unit of heat" used in this country, is the "British Thermal Unit," and this is the amount of heat required to raise one avoirdupois pound of pure water one Fahrenheit degree in temperature, from the temperature of maximum density of water, which is 39.1 degrees Fahrenheit. The variation in quantity of heat necessary to raise the temperature of a pound of water one degree, is so slight for any temperature between 32° and 212° that in general the heat unit may be safely taken as the amount of heat necessary to raise the temperature of one pound avoirdupois of pure water one degree Fahrenheit. Thus we may say that to raise the temperature of 30 pounds of water from 40° to 60° Fahrenheit requires 600 British Thermal Units; for we have raised 30 pounds of water through 20° of temperature, and to raise 30 pounds of water one degree requires 30 British Thermal Units, or "units of heat," or "heat units"; and to raise the same quantity through 20 degrees requires 20 times as much, or 600 "heat units."

By quantity of heat is meant the total amount of heat possessed by a body or involved in any thermal operation. It depends not only on the temperature or change in temperature, but also upon the weight of the body affected and the capacity for heat of the substance of which this body is composed. Thus a pound of water and a pound of lead at the same temperature contain very different quantities of heat, since the capacity of the lead for heat is only .0314 times that of the water.

Intensity of heat or temperature is entirely independent of quantity, since we may have a small quantity of heat of high intensity, such as the heat in a needle raised to incandescence, or a large quantity of heat of low intensity, such as the heat in a large steel bar at a temperature of say 100° Fahr.

All bodies, no matter what their temperature, within the range of temperatures so far obtained possess a certain quantity of heat, but no body can impart any of the heat that it possesses to another body unless the intensity of this heat is higher than that of the heat in the body to which it is to be imparted and this is entirely independent of the relative quantities of heat possessed by the two bodies. Thus a cubic foot of water at a temperature of 60° will possess a greater quantity of heat than a cubic foot of lead at a temperature of 100°; but if they are brought together the lead will impart heat to the water and not the water to the lead.

The amount of heat that can be transferred between different bodies depends upon the quantity of heat possessed by the hotter bodies, and not merely upon the difference in temperature. Thus a pound of water at a temperature of 70° Fahr. can impart more heat to a pound of water at a temperature of 60° Fahr., than can a pound of iron at a temperature of 100° Fahr. From these examples it can be seen that quantity of heat does not depend solely upon intensity, though of course for any definite weight of a given substance the quantity of heat possessed will vary directly as the intensity of the heat. (Trustees.)

6. A gas with a specific gravity of .750 is carried by a street main over a hill 85 feet high. The gas is at rest for the time. The pressure in the pipe as shown by a syphon gauge at the foot of the hill is $\frac{15}{10}''$. What will be the pressure shown by a gauge attached to the pipe at the top of the hill? Give your calculations.

Ans. From the answer to question No. 6 of the Third Series for 1900, we find that the amount of the difference in gauge pressure between the upper and lower ends of a gas pipe laid on an incline can be obtained by dividing the difference between the weight of a column of air with an area of one square inch and a height equal to the difference in elevation between the two ends of the pipe and that of a column of gas of the same area and height, by the weight of a cubic inch of water.

In this case the difference in elevation between the ends of the pipe is 85′ and the specific gravity of the gas is given as .75. A column of air one square inch in area and 85′ high will contain $85 \times 12 \times 1 = 1020$ cubic inches, and since the weight of a cubic inch of air is .00004418 lb., the weight of this column will be $1020 \times .00004418 = .0451$ lb. Since the gas has a specific gravity of .75, the weight of the column of gas will be .75 times the weight of the column of air, and the difference between the weight of the column of air and that of the gas will be .25 times the weight of the column of air. This difference will therefore be $.0451 \times .25 = .011275$ lb. The weight of a cubic inch of water is .036 lb., and the increase in pressure will be $.011275 \div .036 = .31''$, and the pressure at the top of the hill will be equal to the pressure at the bottom plus this difference, or to $\frac{15}{10}$ plus $\frac{3}{10} = \frac{18}{10}''$. (Trustees.)

7. In the answer to question No. 7, Third Series, 1900, the yield of ammoniacal liquor per ton of coal is given as 30 gallons of from 8 to 10 oz. (4° to 5° Twaddel) strength. What is the meaning of a degree Twaddel and of an ounce when used in this connection?

Ans. The statement that an ammoniacal liquor has a strength of a certain number of degrees Twaddel really means that the specific gravity of the liquor is such that a Twaddel hydrometer inserted in it will show a reading of the stated number of degrees. As there is a more or less close relation between the specific gravity of ammoniacal liquor and the amount of ammonia that it contains per unit of volume this Twaddel test affords a rough indication of the strength of any given liquor.

The hydrometer consists of a bulb loaded with mercury or shot, and surmounted by a hollow cylinder above which is a graduated tube, all being made of glass. The bulb is so loaded as to cause the hydrometer to be almost completely submerged when floating in distilled water with a temperature of 60° Fahr. The point of the tube which is even with the surface of the water under these conditions, is marked as the o of the scale, which is then continued downwards on the tube in degrees and parts of degrees, each degree corresponding to an increase in the weight of the liquid of 5 oz. per cubic foot. The tube is usually made of such a length as to contain a scale reading to 25°. When the hydrometer is placed in a liquid heavier than water, such as ammonical liquor, the volume of liquid required to be displaced in order to float the instrument is, of course, smaller than the volume of water required for this purpose, and the hydrometer will not be as deeply submerged as it is in the water. The point of the scale which is at the level of the surface of the liquid when the hydrometer is floating at rest, and not in contact with the sides of the containing vessel, is noted, and the liquid is said to be of a corresponding number of degrees Twaddel strength.

The value of ammoniacal liquor is commercially expressed also by the number of ounces by weight of pure monohydrated sulphuric acid ($H_2 SO_4$) of 1.84 specific gravity, which is required to saturate the ammonia contained in one gallon of the liquor. For instance the liquor is said to be of 8 oz. strength when it contains per gallon a quantity of ammonia which requires 8 oz of pure sulphuric acid of 1.84 specific gravity for its neutralization.

In determining the strength in ounces of any sample of ammoniacal liquor, accurate results cannot be obtained by adding the acid directly to the liquor. It is necessary to distill the liquor after adding to it a caustic alkali, such as caustic soda or milk of lime, and to use the acid to neutralize the ammonia as it is driven off by this distillation.

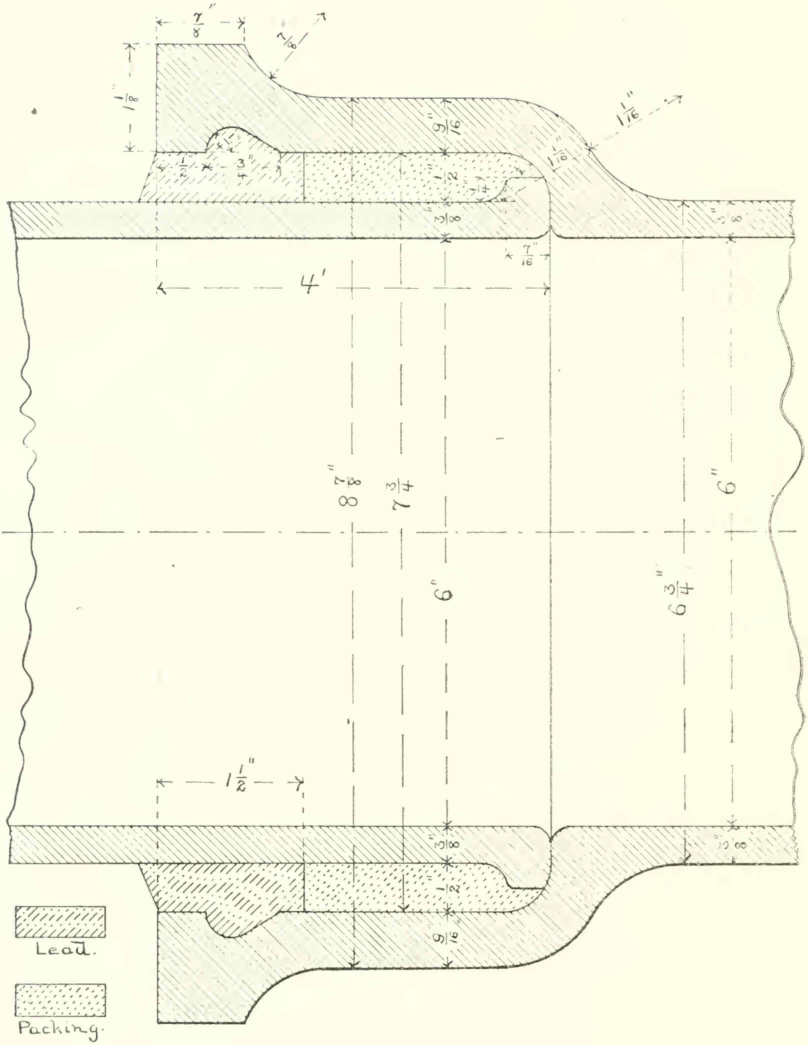
It is commonly considered that each degree Twaddel corresponds to a strength of 2 oz., but this is only an approximation and the strength of ammoniacal liquor should always be determined by the distillation test, which should be specified in all contracts for the sale of such liquor. (Trustees.)

8. Describe—with sketch of a longitudinal section of both spigot and hub, showing outside diameter of spigot, all dimensions of the hub or bell, the shape of the lead groove in the bell, and the depth and finished shape of the lead—the making of a lead joint in a 6″ cast-iron main. Give also the amount of lead and packing used and the length of time that should be required to do the work.

Ans. In making a lead joint in a 6″ cast-iron main, the first step in the operation, after the spigot end of one length has been inserted in the bell of the other and the length driven home, lined up and fixed in place by the tamping of a little dirt around the middle of it, is to fill solidly with packing, a portion of the joint space between the spigot and bell, the amount of space so filled being determined by the depth of lead which it is desired to have. For ordinary straight work with 6″ pipe, the depth of lead may be taken at 1½″, and the joint space will therefore be filled with packing to a point 1½″ back from the face of the bell.

Jute packing, either plain or tarred is usually employed. Packing which has been allowed to absorb a small quantity of tar can be driven tighter than plain packing, but tar being cheaper than jute it is hard to avoid the presence of too much tar in tarred packing, and for this reason plain packing is often given the preference.

A sufficient number of strands of packing should be twisted to form a rope of a diameter a trifle larger than the width of the joint space, and this should be cut into pieces of such length that the ends will come into close contact when a piece is placed around the outside of the spigot end of the pipe and pulled up tight. One



Section of 6 in. Bell, Spigot and Lead Joint.

American Gas Light Association Standard.

of these pieces is used to lift the spigot end as it is inserted into the bell of the pipe previously laid, and is sent home with it, thus keeping the spigot central in the bell and avoiding the necessity of wedging it up after it is in place. This piece of packing is driven solidly into place in the bottom of the joint space by means of a caulking hammer and packing iron, and other pieces are inserted one at a time, the joint in each ring being put say one-fourth of the circumference away from the joint in the preceding ring, and each driven home, a sufficient number being used to fill the joint space to the required depth, leaving 1½″ for the lead. The packing must be driven hard and the finished layer must be of uniform depth so that the lead space will be uniform all around the pipe.

A clay roll or other form of joint runner is then placed around the spigot end of the pipe, being brought tight against the face of the bell, and so set as to leave a triangular space, having its base on the pipe and its apex on the face of the bell slightly above the inside edge, which the lead can fill and thus make it certain that when driven, the joint will be of the shape shown on the cut. Molten lead is run into the joint and this space until both are completely filled and the lead stands above the highest point on the inside edge of the bell, the lead being poured in through an opening, or "gate" left on top of the pipe. When the lead has hardened the joint runner is removed and the "gate" or lump of lead where the opening for pouring was made is cut off. The lead is then chiseled all around the pipe with a cold chisel and caulking hammer. This separates the lead from the surface of the pipe and makes a groove in which the first caulking tool, the face of which is about 3/16″ thick, can fit. The lead is driven all around with this tool and then with tools successively increasing in thickness about ⅛″ until the full width of the joint has been reached. The work with each tool should be begun at the bottom of the pipe and carried around each way finishing up at the top. The thickness of the last tool used should not be greater than the width of the joint, and the driving with this tool should cut the lead off sharp with the inside edge of the bell, otherwise there is danger that the force of the blows will be expended against the face of the bell instead of doing the full amount of work that it should do in compressing the lead in the joint. In order to have the tools fit the joints exactly it is well to have them made in sizes varying in thickness b

$\frac{1}{16}''$, though it is only necessary to use on any joint tools varying by $\frac{1}{8}''$, the proper sizes being selected. The position in which the tools are naturally held when caulking the joint will give it the finished shape shown on the cut, if the joint runner has been put on properly and sufficient lead used.

There will be required for making a 6″ lead joint about 7 to 8 lbs. of lead, and 7 to 10 oz. of jute packing. A good workman should be able to average nearly 3 joints an hour for a day's work.

The cut shows the spigot and bell of the standard dimensions adopted by the American Gas Light Association in 1898. (Trustees.)

9. What is a Holophane Globe and how does it affect the useful light given by the source of light over which it is used?

Ans. The Holophane globe is a globe which diffuses the light from a light source enclosed by it, in such a way as to make the whole surface of the globe appear luminous and at the same time changes the distribution of light in vertical planes and throws a larger proportion of the total light in the direction which will prove the most useful for any particular case.

The diffusion of the light is effected by the combination of vertical corrugations on the interior of the globe, the effect of which is to spread the light horizontally, with horizontal prismatic mouldings on the exterior surface which spread the light vertically. The shapes of both the corrugations and the mouldings are carefully designed to secure the transmission of the largest possible percentage of the light through the glass, and the prisms forming the mouldings are also designed to refract as much as possible of the light in a definite direction.

Thus one form of globe, used for lighting a desk or table by means of lights on a chandelier above it, is so made as to direct the larger proportion of the light downwards; another, used for the general illumination of rooms by means of lights on the chandeliers, distributes the light uniformly in the hemisphere below the horizontal plane passing through the light source, while still another form, used for street lighting, causes most of the light to be given off in the space between this horizontal plane and the cone generated by the revolution of a line drawn through the light source at an angle of 45° with the plane.

Each style requires special forms for the prisms on the exterior surface, and it is also necessary that the forms of these prisms on any one globe vary with their position relative to the source of light, since the rays of light cannot be refracted in parallel directions by prisms of the same shape, when one receives horizontal rays and the other rays at an angle of, say, 45° with the horizontal.

The use of Holophane globes is especially advisable with incandescent gas lights for two reasons. In the first place the intensity of the light is too great to permit of its being used unshaded for ordinary interior lighting. The diffusion effected by the Holophane globe overcomes this objection with the least possible loss of light, since, owing to their design, these globes absorb very little more light than is absorbed by plain glass, while an opal or tinted globe sufficiently dense to cut off the direct view of the light source will absorb a large proportion of the total light emitted by the source. In the second place, the light emitted by a naked incandescent light is, owing to the shape of the mantle, given out principally in a horizontal direction, and so is not available, when as is usually the case, the light is above the surface to be illuminated. By changing the direction of the rays the Holophane globe actually increases the amount of light made useful in cases of this kind, the absorption of the glass being more than counterbalanced by the extra rays drawn aside from the illumination of space where only a slight illumination is needed, and made to take a more useful direction. The total spherical illumination, that is the illumination of the whole space surrounding the light, is of course diminished by an amount equal to the light absorbed by the globe, the increase in the amount of light at the points where it is to be used being obtained at the expense of the amount at the points where it is not needed. (Trustees.)

10. In setting a gas range which has an oven burner and four top burners, what size of pipe should be used, and to what size meter should it be connected.

Ans. A gas range having four top burners and an oven burner should be connected to the meter by ¾″ pipe, if the range is not more than 50′ to 60′ from the meter, and by 1″ pipe if the distance is greater than this. The meter should not be smaller than 5-light.

A gas range of this description will consume, when all the burners are in use and burning full, at least 60 cubic feet of gas per hour. On a length of 50′, the passage of gas at this rate through $1\frac{1}{2}$″ pipe would result in a loss of pressure of from $\frac{4}{10}$″ to $\frac{7}{10}$″ according to the specific gravity of the gas, the limits taken for this specific gravity being .400 and .700. Even the smallest loss is too large, and therefore $\frac{3}{4}$″ pipe must be used. On a run of 60′, $\frac{3}{4}$″ pipe will, at the above rate of consumption, cause a loss of pressure of $\frac{2}{10}$″, with gas having a specific gravity of .700, so for runs longer than this 1″ pipe should be used, since unless the pressure in the street mains is high, it is not advisable to lose even $\frac{2}{10}$″ pressure in the piping.

According to a table given in a paper entitled "The Measurement of Gas" read in 1897 by Mr. C. W. Hinman, before the New England Association of Gas Engineers, and published in the American Gas Light Journal, volume 66, page 401, a 3 light meter passing 60 cubic feet of a mixed coal and water gas per hour, causes a loss of pressure of .37″. Mr. Hinman does not consider this loss too large, and concludes that a 3-light meter is large enough to supply a gas-range if this is its sole duty. But a loss of this amount of pressure added to the loss suffered in the piping would, in most localities, make the pressure at the gas orifices of the range burners so low that it would be impossible to obtain a good atmospheric flame, and in practice it has been found best to use a 5-light meter with a range of this description, even when the meter supplies nothing but the range. It is even more necessary that nothing smaller than this size should be used when the meter has to supply the gas for lighting the house as well as that needed for the range. In fact, if the range is a large one, consuming say, 80 to 100 cubic feet per hour, when all the burners are in use, a 10-light meter will be required to satisfactorily supply gas for both the range and the house lighting. (Trustees.)

11. What are the rules by which to determine the proper size of house piping to be used, when the number of lights to be supplied, and the length of pipe along which they are to be placed, are known?

Ans. There are several sets of rules in use by gas companies for the determination of the proper sizes for house piping, when the number of lights to be supplied and the length of run are known. The majority of these are copied from the English rules, which are apparently based upon a specific gravity for the gas of .420, and a loss of pressure of $\frac{1}{10}''$ in 30′ of piping, and the sizes of pipe determined by them are too small when carburetted water gas, or a mixture of this gas and coal gas is supplied. In 1897 the American Gas Light Association instructed its Research Committee to prepare a table for house piping based upon a loss of pressure of $\frac{1}{10}''$ for each 50′ of pipe, with gas of a specific gravity of .680. This table was reported by the Committee and adopted by the Association in 1898, and is given below.

Diameter inches.	Length feet.	Gas per hour cubic feet.
⅜	20	11
½	30	22
¾	50	60
1	70	127
1¼	100	222
1½	150	349
2	200	718
2½	300	1253
3	450	1977
4	600	4059

No greater length of pipe should be used than is given in the table, e. g. the maximum length of 1-inch pipe allowable under any circumstances is 70 feet, and it should not be expected to carry over 127 cubic feet of gas per hour.

In using this table it is necessary to determine from the number and character of the lights to be supplied, the amount of gas which each portion of the house-piping system will be required to carry, and, in addition, to obtain from the plans the lengths of these portions. Knowing the quantity of gas and the length of pipe through which it is to be supplied, the table indicates the size of pipe which will pass the required quantity of gas with a loss of pressure equal to, or less than, $\frac{1}{10}''$ in 50′. This figure for the loss of pressure was adopted, after a long discussion, as the one which best met all the requirements. The discussion can be found in Vol. XIV of the Proceedings of the American Gas Light Association, pages 122 to 130, immediately following the report of the Research Committee in 1897. (Trustees.)

FIRST SERIES OF QUESTIONS, 1901—SECOND SECTION PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

1. What tests would you apply to a fire brick to determine its quality?
2. What are the precautions that should be taken in laying fire brick and fire clay blocks to secure for the finished work strength and the ability to resist heat?
3. Describe—with sketches giving a vertical cross section, a vertical longitudinal section and a horizontal longitudinal section showing the nostrils in the furnace arch, the secondary air openings into the combustion chamber, and the openings through which the hot waste gases pass into the recuperators – a setting of six retorts heated by a generator furnace and equipped with recuperators. Neither furnace nor recuperators need be illustrated except to the extent required to show the above mentioned openings.
4. Describe some system of machinery for drawing coke from coal-gas retorts by steam or hydraulic power.
5. Is it possible to have a single automatic overflow to remove both tar and liquor from the hydraulic main and at the same time maintain a liquor seal of constant depth on the dip pipes? Illustrate the reasoning by which you arrive at your answer by a sketch showing a cross section of the main and of such an overflow.
6. Boilers are often rated as being of so many horse-power. What is the meaning of the term "horse-power" when used in this connection? What is the meaning of the same term when applied to steam engines?
7. What horse-power is required for the actual work of pumping the gas by an exhauster handling 25,000 cubic feet of gas per hour with an inlet pressure of $\frac{5}{10}''$ and an outlet pressure of $9''$?
8. What is the maximum amount of gas containing 2.5 per cent. of carbonic acid, CO_2, that can theoretically be purified by a bushel of unslaked lime containing 85 per cent. of calcic oxide, CaO, assuming that the weight of a bushel is 80 lbs. and that carbonic acid only is to be removed from the gas by the lime? Give all your calculations.

9. How would you calculate the maximum temperature that can be produced by burning any given sample of gas, the oxygen for combustion being derived from the atmosphere?

10. Describe some method of making iron oxide to be used for the removal of sulphuretted hydrogen from gas during its purification.

11. What is meant by the statement that a gas is saturated with vapor at a certain temperature and pressure?

12. What is the Principle of the Conservation of Energy?

(Answers to these questions are due March 7, 1901.)

FIRST SERIES OF QUESTIONS, 1901—THIRD SECTION—PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

1. What are the respective advantages and disadvantages of anthracite coal, gas coke, and furnace coke when considered with reference to their use as the fuel in the generator of a carburetted water-gas apparatus?

2. After having heated up and put into regular operation a bench of retorts, full depth regenerative setting, how would you proceed to adjust the chimney dampers and primary and secondary air slides in order to secure the greatest fuel economy?

3. Describe, with sketches, one or more forms of scrubbers used for removing ammonia from coal gas. If you are not familiar with coal gas apparatus, describe, and sketch, the so-called scrubber used in connection with a carburetted water gas plant.

4. The answer to question No. 4, Fourth Series, 1900, states that the speed of an exhauster in a coal gas plant should be governed in such a way as to be increased when the rate at which gas is made increases, and to be decreased when the rate at which gas is made decreases. Describe, with sketches, a form of governor that will automatically regulate the speed of an exhauster according to these requirements?

5. Give in British thermal units the heating power of a pound and of a cubic foot of each of the following gases:

Hydrogen	H
Methane or Marsh Gas	CH_4
Ethylene or Olefiant Gas	C_2H_4
Carbonic Oxide	CO
Acetylene	C_2H_2

6. What is the effect of heat upon the volume of any given weight or quantity of gas, and what bearing has this effect upon the question of the measurement of gas?

7. How much pure ammonia gas (NH_3) is contained in a gallon of ammoniacal liquor which has a strength of 10 oz.?

8. What is the minimum size of pipe which it is considered advisable to use for services for ordinary dwelling houses? Give the reasons for your answer.

9. Flat flame burners are of two kinds, known respectively as fishtail and batswing burners. Give a description of each kind, and state which will give the greatest amount of light from a given illuminating gas, the gas being consumed under the proper conditions to give the best result in each case.

10. Describe some economical form of gas water heater for use in connection with the ordinary kitchen boiler.

11. What is meant by the term "light" used in designating the size of meters? Is its value the same in small meters, such as 3-lights, as in large meters, such as 100-lights?

12. In what part of the masonry or brick-work of a gas works would you use cement mortar instead of lime mortar, and why?

(Answers to these questions are due March 1, 1901.)

First Series of Questions, 1901—Fourth Section—Practical Class—American Gas Light Association.

1. What is coal gas? What is water gas? What is carburetted water gas? What is oil gas? What is the average composition of each kind of gas?

2. What are the properties that must be possessed by a coal to fit it for being used for the manufacture of coal gas?

3. Name the chief impurities in crude coal gas as it leaves the retorts and give the reasons why they should be removed from the gas before it is distributed.
4. Name the useful by-products or residuals produced in addition to the gas in the manufacture of coal gas. In the manufacture of carburetted water gas.
5. Name the principal pieces of apparatus necessary in a carburetted water gas works, and state briefly the function of each.
6. Name the principal pieces of apparatus necessary in a coal gas works, and state briefly the function of each.
7. What does the ordinary U or syphon gauge indicate, and what is the object of its use in gas works?
8. How does a suction pump "draw" water? Why and how does a hot chimney "draw"?
9. Why is it necessary to provide for draining all mains and pipes through which gas travels, and how is this done?
10. What is the commonly accepted theory as to the cause of the luminosity of the flame produced by burning illuminating gas in a luminous burner?
11. Why is the flame of a Bunsen or atmospheric burner non-luminous?
12. What is common lime and what is the raw material used in its manufacture? What is hydraulic lime and what is the raw material used in its manufacture? What is hydraulic cement and what is the raw material used in the manufacture of natural hydraulic cement?

(Answers to these questions are due March 1, 1901.)

CIRCULAR TO MEMBERS OF THE FOURTH SECTION OF THE PRACTICAL CLASS.

You will find enclosed the first series of questions for your section. A similar series will be sent out each three months, but no series will be sent to any member of the class who has not sent in answers to the questions of the preceding series within the time specified for the receipt of such answers, or failing this has secured an extension of time by presenting to the Secretary a good and valid excuse for such failure. All answers will be carefully examined by the Secretary, and each member of the regular class will be sent a criticism of his work on each series of questions based upon such examination. Members of the class should therefore keep copies of their answers in order to fully understand the criticisms. Those members of the class who answer all the questions as sent out will be continued in the class for three years, this period having been fixed upon by the Trustees as the length of time to be given to the course. The work of the members of the Special Section of the class will not receive the criticism of the Secretary, but otherwise, the rules governing the work are the same for both the special and the regular members.

Before making up their answers the students are at liberty to use any and all means of securing information at their disposal, with the following exception. Some of the questions having already been used for previous sections the answers to them have been published in the Proceedings of the American Gas Light Association. The answers thus published should not be consulted by the student while preparing his answers. Answers should be written, as far as possible, in the student's own language, based upon the knowledge acquired through his study of the subject covered by the questions, and not copied directly from any text book or source of information, and care should be taken that the desired meaning is clearly and concisely expressed, and that reasons for the statements made are given.

It is assumed by the Trustees that admission to the class is sought solely from an earnest desire to derive all the benefit that can be obtained from the work carried on by its members. It is therefore expected that the members of this new section will work faithfully and adhere strictly to the rules governing the time for sending in answers.

Answers to this first series must be in the hands of the Secretary not later than March 1st.

Please write your name and address at the head of the first page of answers

Please write your answers on one side of the paper only.

The Secretary will be pleased to hear from any member of the class who does not understand any questions, and will endeavor, to the best of his ability, to help any such inquirer out of his difficulty.

Please address all communications, answers to questions, etc., to Alfred E. Forstall, Secretary, Room 22, 58 William Street, New York City, and put on the envelope your name and address.

January, 1901.

ANSWERS TO FIRST SERIES OF QUESTIONS, 1901—SECOND SECTION—PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

The answer to Question No. 12 has been published in Vol. XVI of the Proceedings, page 59, and can be found there. The answers to the other questions are as follows:

1. What tests would you apply to a fire brick to determine its quality?

Ans. The qualities desired in a fire brick are: infusibility, strength, regularity of shape, uniformity of composition and facility of cutting, and the tests to be applied to a fire brick should be such as will determine to what extent it possesses these qualities.

The degree of infusibility can be determined, to a certain extent, by an analysis of the material of which the brick is composed. If this analysis shows the presence of about 60% of silica, less than 6% of sesqui-oxide of iron and not more than 2% to 3% as a total of lime, magnesia and the hydrates of potassium and sodium, the brick probably possesses a high degree of infusibility. If the analysis shows more than 6% of sesqui-oxide of iron or 2% to 3% of the lime, magnesia, etc., the brick should be rejected. But exposure of the brick to the action of heat under the conditions to which it will be subjected when used furnishes the best test for infusibility. In coal gas works the test can be made by placing the brick in the combustion chamber of a regenerative bench. If, when the brick is removed after being exposed for a week or ten days to the heat of the combustion chamber, the edges and corners are found to be sharp, and the surfaces show no signs of incipient fusion the brick may be passed as of first rate quality, as far as infusibility is concerned. In water gas plants the space at the bottom of the superheater, in which the secondary combustion occurs, furnishes a good place for a test.

If the material of which the brick is made is well compressed during manufacture and the brick is hard burned there is no question as to its strength when cold. The degree to which compression has been carried is indicated by the weight of the brick, and a fire brick of the regulation size, 9″ × 4½″ × 2⅝″, should weigh from 7¼ to 7½ lbs. A well burnt brick usually shows a reddish tinge. A well compressed and well burnt brick will give a ringing sound when struck with a hammer. It is especially important that the bricks which are to be used for lining the furnaces of retort benches, or for lining water gas generators, should be hard, since they are subjected to a great deal of abrasion from the fuel and the clinkering bars, so that for this work hardness and strength are of more importance than infusibility. In the combustion chamber, on the contrary, infusibility is the most important quality, since the material used there is not exposed to any wear and tear except that arising from the effect of the heat It may thus frequently happen that the same brick is not suitable for use both in the furnace and the combustion chamber.

An examination of the exterior of the brick is all that is necessary to determine whether or not it possesses regularity of shape.

Uniformity of composition can be tested by breaking the brick and examining the surface of the fracture. This should present a compact and uniform appearance though not necessarily a close and fine texture. In fact some authorities consider a coarse texture the more preferable. Uniformity of composition is also indicated by the giving out of a clear ringing sound when the brick is struck a sharp blow with a hammer.

Facility of cutting is important only as reducing the cost of labor and the amount of waste during the operation of laying the brick, and while desirable if it can be secured without sacrificing the more important qualities it cannot be considered an equivalent for any one of them. (Trustees.)

2. What are the precautions that should be taken in laying fire brick and fire clay blocks, to secure for the finished work strength and the ability to resist heat?

Ans. The principal precautions to be taken in laying up fire bricks or fire clay blocks are that the bricks, or blocks, should be well wetted just before they are laid in place, and that each brick, or block, should be rubbed into place in such a way as to bring its faces almost into contact with the faces of the adjacent bricks, or blocks, in the wall, the joints being made as thin as it is possible to have them and at the same time have the fire clay fill all the interstices so as to give a uniform bearing over the whole surface.

This is especially important in the case of arches, which should be laid as nearly as possible with the blocks face to face. Bricks and small blocks can be wet by dipping them into water in a bucket, kept filled and at hand for the purpose, each piece being dipped by the mason as he picks it up for the purpose of laying it in place in the wall. The surfaces of large blocks should be wet by having water sprinkled on them, a convenient method being to employ for the sprinkling a whisk broom which is wet by being dipped into the water in the bucket. The portion of the work previously laid, upon which the bricks, or blocks, are to be placed, should also be wet in the same way.

To secure thinness of joints, those surfaces of the blocks which come together should be smooth plane surfaces, being dressed to this condition if they do not originally possess it, and the fire clay must be mixed thin rather than stiff, care being taken not to get it so thin that it will run out of the joint, nor so stiff that any excess will not be squeezed out when the block is worked into place. If the joints are not made thin the fire clay will soften and run out of them when the work is subjected to heat, or even if it does not do this it will shrink under the action of the heat and cause a settlement of the upper part of the brick work.

Another precaution which should be observed is that when it is necessary to cut bricks or blocks the cut surfaces should never be exposed to the direct heat of the fire, the face so exposed being always one which has not been cut. (Trustees.)

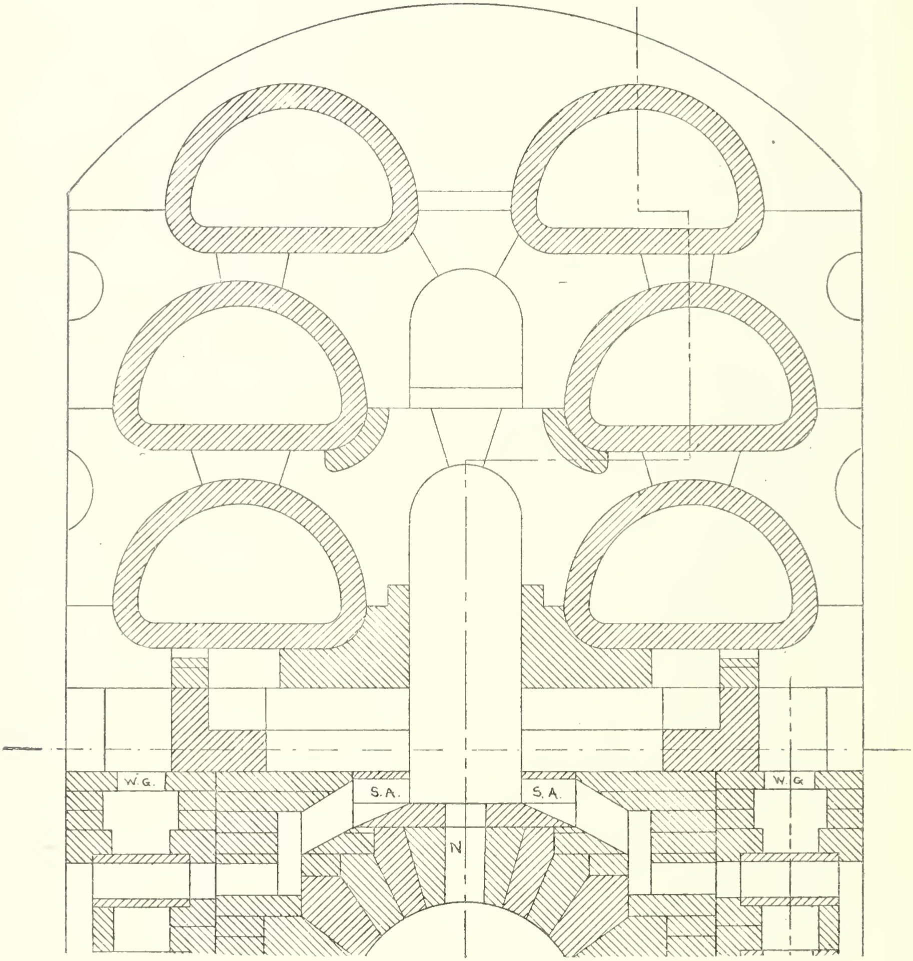
3. Describe—with sketches giving a vertical cross section, a vertical longitudinal section and a horizontal longitudinal section showing the nostrils in the furnace arch, the secondary air openings into the combustion chamber, and the openings through which the hot waste gases pass into the recuperators—a setting of six retorts heated by a generator furnace and equipped with recuperators. Neither furnace nor recuperators need be illustrated except to the extent required to show the above mentioned openings.

Ans. The regenerative setting of six retorts, which is illustrated by the accompanying sections, is designed to be built in an arch 8′—4″ wide and to contain retorts, the inside measurements of which are 15″ × 26″ × 9′—0″.

As will be seen from the cross section, the combustion chamber is made wide and high, being 14″ wide and 3′—6″ from the top of the furnace arch to the bottom of the first arch of the setting

Bench of 6 Retorts. Regenerative Setting.

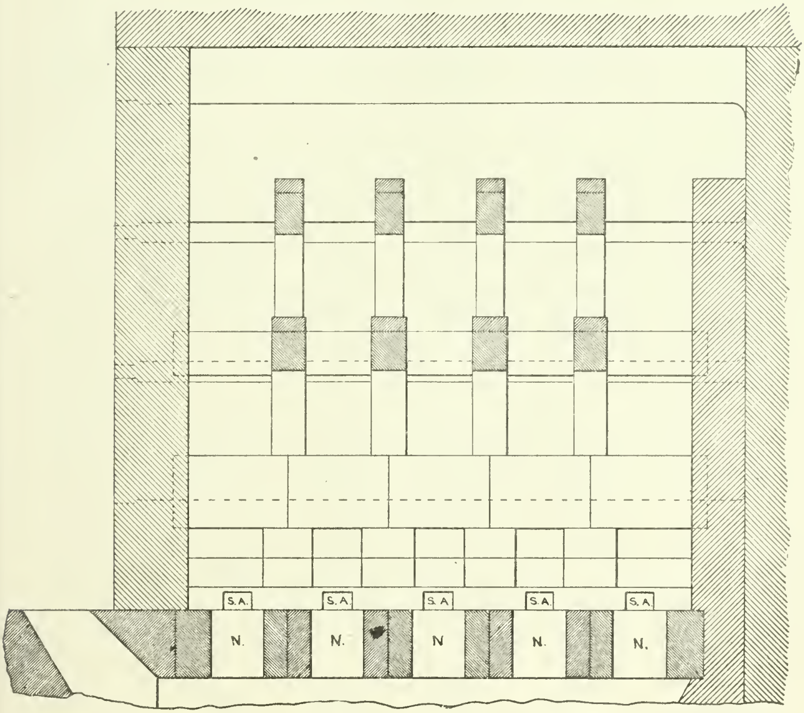
Vertical Cross Section.



which crosses the combustion chamber. The producer gas enters this chamber by five openings, or nostrils marked N, spaced equal distances apart from front to back along the centre line of the bench. The secondary air is admitted through the openings marked S A. There are five of these on each side of the combustion chamber, level with the top of the furnace arch, each nostril having a secondary air opening opposite it on each side so that two streams of secondary air are directed against each stream of producer gas.

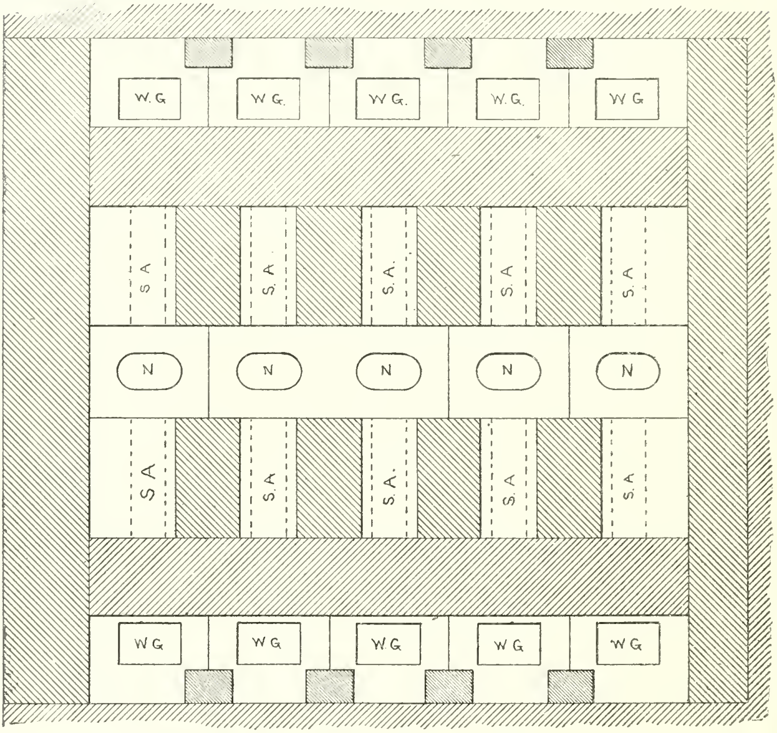
Bench of 6 Retorts. Regenerative Setting.

Vertical Longitudinal Section.



The setting is built in one single chamber, the combustion taking place and the hot gases passing up around the retorts along the full depth of the bench. To secure effective heating of the bottom of the bottom retorts small passages, which lead out of comparatively large openings left under the bottom retorts, as shown on the sections, carry some of the hot gases directly from the lower part of the combustion chamber to the outside flues. The bulk of the products of the secondary combustion, however, pass upwards and around the retorts, a portion passing out between the top of the bottom retort, and the bottom of the middle retort, another portion passing out between the middle retort and the top retort, and the remainder going to the top of the setting and passing over the top of the top retort on each side. In whatever way the gases reach the space between the retorts and the outside wall on each side, they are drawn down through this

Bench of 6 Retorts. Regenerative Setting.
Horizontal Longitudinal Section along line
A B on the Vertical Cross Section



space to the bottom of the setting and pass down into the recuperators through five openings. These openings, marked W.G. on the sections, are spaced, like the nostril openings, equal distances apart from front to back of the bench and by them an even distribution of the waste gases through the whole depth of the recuperators is secured.

The setting is a skeleton one, no more bricks and blocks being used than are necessary to support the retorts and prevent the heat from passing out the front of the bench. For the latter purpose the front wall is made 13″ thick. The retorts are supported at the front by this front wall, at the back by a wall 9″ thick and at four points between these walls by blocks made of the proper shape to fit the outside of the retorts and form supporting arches, which carry the retorts and relieve the lower ones of the weight of those above them. The blocks supporting the inside lower corners of the bottom retorts are made continuous for the whole length of the retorts so as to protect them from the great heat existing in this part of the setting and from the cutting action of the flame, and shield tiles are also provided for the inside lower corners of the middle retorts for the same object. At all other points the retorts are exposed to full contact with the products of combustion except where they are built in the front and back walls, or where they rest upon and are covered by the narrow supporting blocks. Since these blocks are only 5″ or 6″ wide it will be seen that much the largest portion of the surface of the retorts is exposed to the direct action of the heat.

The blocks and bricks forming the walls of the combustion chamber should be made of extra quality material in order to stand the heat to which they are exposed. The blocks above the top of the bottom retorts on the inside of these retorts and all the blocks on the outside of the retorts may be made of any good first quality material. (Trustees.)

4. Describe some system of machinery for drawing coke from coal gas retorts by steam or hydraulic power.

Ans. The machines which have been devised for drawing the coke from coal gas retorts have proved more successful than the machines for charging such retorts that have been brought forward by the same inventors, and these drawing machines are frequently used in connection with hand charging. The drawing machine described below is a companion to the charging machine described in the answer to question No. 3 of the Fourth Series for 1900, and is one that has been installed in most of the works in this country which have adopted machine drawing during the last few years.

The machine is composed of a carriage, or platform, and of the machinery required for doing the work of drawing the retorts, all of which is mounted on the platform. This is itself carried on wheels running in a track laid on the charging floor of the retort house in front of, and parallel to, the face of the retort stack. The same track serves for both charging and drawing machines, when both are used. On the platform are the steam boiler, an engine for moving the machine along the track, and the rake carrier and rakes for drawing the coke from the retorts, together with the mechanism for working the rake carrier. In some installations the boiler is omitted, the steam required for working the machine being obtained from the steam system of the gas works, through a flexible joint which permits of the travel of the machine from end to end of the retort stack.

The engine and mechanism for moving the machine, and stopping it at the proper points in front of the retorts, are similar to those used for the same purpose on the charging machine.

The rake carrier and the rakes, of which there are usually three arranged vertically one above the other, are carried on a frame work consisting of two uprights, one at the back and one at the front of the platform, properly braced and tied together by horizontal members which form guides, on which run the rollers of the rake carrier. This carrier consists of two pieces of plate iron kept the proper distance apart by distance pieces. The four guide rollers are set between the plates, two bearing against the bottom of the upper guide and two running on top of the lower guide. The rake bars, or, as they might be called, the rake handles, pass between the two plates of the carrier and are attached to it by pins going through holes in both plates and in the rake bars which come opposite each other when the bars are in the proper position. If a rake is not needed, owing to the scurfing or repairing of a retort, it is disconnected from the carrier by pulling out the pin and is then fastened to the main carriage by a pin going through an extra hole in the bar and through a corresponding hole in a fixed plate fastened to this carriage. As the rakes are carried backward and forward by the motion of the carrier the bars run on rollers fixed to a frame, this frame being so arranged that it can be raised and lowered by means of a hand lever worked by the machine attendant. This permits of the rakes being lifted above the coke, as they are pushed into the retort, and dropped so as to engage with the coke and pull it out as they are withdrawn. To this frame a counterbalance is attached in such a manner that the position of the fulcrum, about which it works, is automatically varied to correspond with the extent to which the rake bars project beyond the frame so that the counterbalancing effect is always proportioned to the weight to be balanced.

Motion is imparted to the rake carrier from a piston working in the horizontal steam cylinder of a direct-acting reciprocating motor, the admission of steam to, and its exit from, this cylinder being controlled by suitable valve gear. The rod attached to this piston carries a hollow cross head, in which there is a pin and upon this pin there turns freely a gear wheel which engages on one side with a fixed rack secured to one of the cross head guides, and on the other side with a flying rack which runs in, or on, the other cross head guide. As the cross head is moved back and forth by the action of the steam on the piston, it carries the gear wheel with it, and, as the teeth of this wheel engage with those in the fixed rack, the wheel revolves at the same time that its centre is being carried forward or backward and its circumference has therefore a lineal or longitudinal motion twice the length of that of the piston and cross head. This motion is imparted to the flying rack, every point of which thus moves twice as fast and as far as the piston. This rack carries two wheels or sheaves. A wire rope fastened at one end to the forward part of the main frame passes back to and around the front sheave, then forward to and around a sheave fastened to the front end of the main frame, and then back to be fastened to the rake carrier. Another rope starting from a fastening at the rear end of the main frame passes forward to and around the rear sheave on the flying rack, then backwards to and around a sheave fastened to the rear end of the main frame and thence forward to be in its turn fastened to the rake carrier. As the sheaves on the flying rack are moved they give to the ropes passing around them lineal motion twice as great as that of their own centres, and this motion is transferred to the rake carrier. Since the sheaves move with the flying rack, which moves twice as fast and as far as the piston, it follows that the rake carrier, which moves twice as fast and as far as the sheaves, moves four times as fast and as far as the piston and therefore the motion of the rakes over the full length of the retort is obtained with a comparatively small motion of the piston.

The longitudinal motion of the steam piston, and consequently of the rake carrier, is controlled by a hydraulic governor, consisting of a piston working in a water cylinder, the cylinder being arranged on the main frame in line with the steam cylinder, and the piston being attached to a rod fastened to the cross head, this rod being practically a continuation of the steam piston rod. The cylinder is counterbored for a short distance at each end to a diameter slightly larger than that of the piston. In each of these counterbored portions there is a small port opening into a passage which brings the two ends of the cylinder into communication with each other. There are also two more ports at each end opening from the body of the cylinder into this passage. The cylinder being filled with water and the piston working in it water tight the rate of motion of the piston cannot be any greater than the rate at which the water can be transferred from end to end of the cylinder through the ports and the passage. As the piston approaches either end of the cylinder it covers first one and then the other of the ports opening out of the body of the cylinder and thus its speed is reduced gradually. The ports in the counterbores being always open the governor does not bring the piston to a full stop, but its speed is so reduced that its motion can be controlled by the steam valve without incurring any risk of knocking out the end of the retort. An enlargement in the water passage, forming an air chamber, provides for the space occupied, on one side of the piston only, by the piston rod, the excess water forced out of the side on which there is no rod and for which there is no room on the other side of the piston, owing to the presence of the rod, being retained in this chamber.

In operating the machine it is brought to the right point by the traversing engine and the retort lids having been slacked off the rakes are run forward into the retorts, being kept raised during their forward motion. When about one-third of the way back into the retorts the rakes are stopped, dropped into the coke and withdrawn, bringing out ahead of them the coke from the fronts of the retorts. They are then raised, run back a little farther than before, dropped and withdrawn, the operation being repeated until the rakes have reached the back of the retort and all the coke has been drawn out. The rakes are then brought back to their original position on the machine and this is moved to the next set of retorts to be drawn and the whole series of operations repeated. (Trustees.)

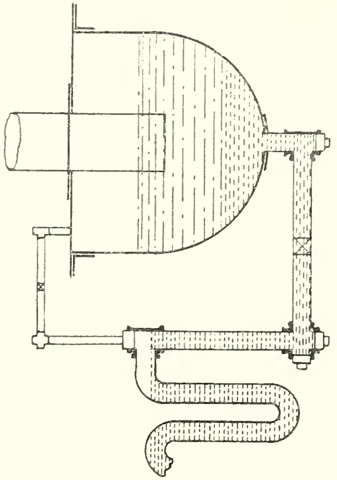
5. Is it possible to have a single automatic overflow to remove both tar and liquor from the hydraulic main and at the same time maintain a liquor seal of constant depth on the dip pipes? Illustrate the reasoning by which you arrive at your answer by a sketch showing a cross section of the main and of such an overflow.

Ans. Owing to the difference between the specific gravities of tar and ammonical liquor it is not possible to have a single automatic overflow for the removal of both tar and liquor from the hydraulic main and at the same time maintain a seal of constant depth on the dip pipes. Such an overflow must connect to the bottom of the main, since otherwise some tar will be allowed to stay in the main indefinitely and gradually stiffen up until it can only be removed by scrapers. The accompanying cut shows cross sections of a hydraulic main with a single overflow opening out of the bottom and serves to illustrate the description of its action which follows.

The main being filled with liquor at the start the conditions are as shown in figure No. 1, the liquor in the two legs of the syphon formed by the main and overflow standing at the same level, and the dip pipes being under the proper seal. But when the main is in operation tar soon accumulates and settles to the bottom, and then nothing but tar can enter the overflow and pass over to its outside leg, as shown on Figure No. 2. In this outside leg there is then a column of tar only, while the balancing column in the other leg is composed partly of tar and partly of liquor. The liquor being lighter than the tar this column of tar and liquor cannot support a column of tar of equal height, and before the tar in the outside leg of the syphon can rise to the level of the overflow and run off, the liquor in the main must rise above this level by an amount which depends upon the length of the outside leg and the proportion of the height of the inside leg which is occupied by the liquor. The seal on the dip pipes will thus be made greater than it should be, as shown on figure No. 2.

Since as long as there is any tar in the main there will be nothing but tar in the outer leg of the overflow and nothing but tar will run off from the main, all the liquor that is formed accumulates, until finally as the tar runs off, the main contains, as shown in figure 3, nothing but liquor standing at a level which is sufficiently

Figure 2.



▤ Liquor

▨ Jar.

Sketches showing how the Seal varies in an Hydraulic Main fitted with a Single Overflow for both Jar and Liquor.

Figure 1.

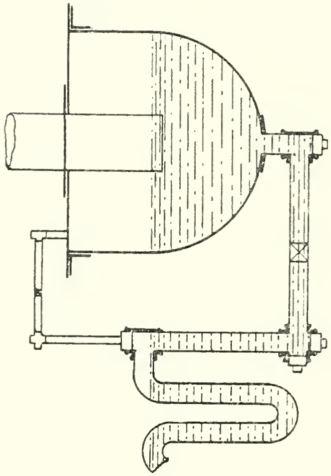
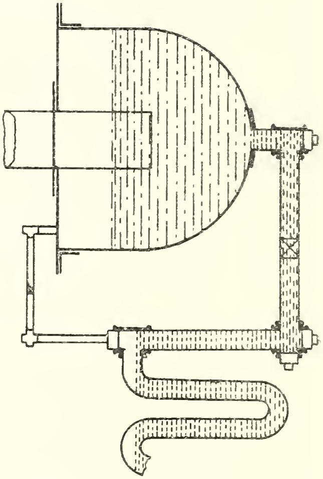


Figure 3.



high to more than balance the tar in the outer leg and drive it out of the overflow. When this happens there will be liquor on both sides of the syphon, and therefore the heights of the two columns will equalize themselves by the rapid flowing out of the liquor from the main until the level has been brought back to the normal water line, at which it will stand until enough tar accumulates to again cut off the liquor from the overflow and fill the outer leg, causing a repetition of the sequence of events previously described.

It is therefore evident that with such an arrangement of overflow the water line in the main is continually varying and the depth of the seal on the dip pipes is anything but constant. To secure a seal of constant depth and at the same time remove both tar and liquor automatically it is necessary to adopt an arrangement of double overflows, similar to that described in the answer to question No. 3 of the third series for 1899. (Trustees.)

6. Boilers are often rated as being of so many horse-power. What is the meaning of the term "horse-power" when used in this connection? What is the meaning of the same term when applied to steam engines?

Ans. The term "horse-power" as applied to the rating of boilers is used in two different ways; either as an absolute unit, by which to measure the rate at which the boiler will work, or as an approximate measure of the capacity of the boiler, to be applied in buying, selling, or describing it for trade purposes.

The trade or commercial horse-power is determined according to certain arbitrary assumptions from the dimensions of the boiler, the extent of the heating surface being usually employed for this rating on a basis of 12 square feet of such surface for each horse-power. Thus, a boiler having a heating surface of 1,200 square feet would be ordinarily rated as being of 100 horse-power. The practice in this respect is, however, not uniform and it is necessary when comparing different ratings of boiler capacity, especially in passing upon proposals for the supply of new boilers, to know upon what rule each rating is based. A rough-and-ready rule for approximating the commercial horse-power of either tubular or water tube boilers has been given by the Engineering News as follows: Multiply the number of tubes by their length in feet and the product so obtained by the diameter of the tube in inches, then divide the final product by 50, and the quotient so obtained will be the horse-power of the boiler. The commercial horse-power is also sometimes determined from the grate surface ⅓ of a square foot being allowed per horse-power.

When used in engineering work for an accurate measure of the rate at which a boiler will do work the term "horse-power" has been defined by a committee of the American Society of Mechanical Engineers as meaning "an evaporation of 30 lbs. of water per hour from a feed-water temperature af 100° F. into steam at 70 lbs. gauge pressure, which shall be considered equal to 34½ units of evaporation, that is to 34½ lbs. of water evaporated from a feed-water temperature of 212° F. into steam at the same temperature. A boiler should only be rated at the power which it is capable of developing with easy firing, moderate draft and ordinary fuel while exhibiting good economy, and should be capable of developing at least ⅓ more than its rated power to meet emergencies."

When applied to steam engines, the term "horse-power" is used to indicate the rate at which mechanical work is done, and denotes the performance of work at the rate of 550 foot pounds per second, or 33,000 foot pounds per minute. A foot pound of work is the work done in raising the weight of 1 lb. through a height of one foot, or of overcoming a resistance of 1 lb. through a distance of 1 ft., or of overcoming any smaller or larger resistance through a correspondingly greater or less space per minute. (Trustees.)

7. What horse-power is required for the actual work of pumping the gas by an exhauster handling 25,000 cubic feet of gas per hour with an inlet pressure of $\frac{5}{10}''$ and an outlet pressure of 9″?

Ans. The term "horse-power" as used to indicate the rate at which mechanical work is done denotes the performance of 33,000 foot pounds of work per minute, that is, the raising of a weight of 33,000 lbs. through a height of one foot, or the overcoming of a resistance of 33,000 lbs. through a space of one foot, or of any smaller resistance through a correspondingly greater space, per minute. The horse-power required to pump gas can therefore be calculated by dividing the product of the resistance overcome and the space through which it is overcome in a minute, by 33,000, the resistance being measured in pounds per square foot and the space in feet. The resistance is determined by the net pressure against which the exhauster is working, that is, by the difference between the pressure at the outlet and that at the inlet of the exhauster. The space can be taken as the number of cubic feet of gas pumped in a minute without any reference to the actual velocity with which the gas passes through the outlet pipe, since with a given outlet pressure the total resistance against which the exhauster is working varies directly as the area of the outlet pipe, while the velocity of the gas, or the space passed through in the unit of time varies, when the same quantity is pumped per minute, inversely as the area of this outlet pipe, and therefore the product of the total resistance and the space passed through will always be equal to the product obtained by multiplying the resistance per square foot by the number of cubic feet of gas pumped in the unit of time. The pressure is usually given in terms of the height, in inches, of the column of water which it will balance, and to convert this to pounds per square foot it is necessary to multiply it by the weight of a column of water one square foot in area and one inch high. A cubic foot of water weighs 62.5 lbs., so a column of water $12''$ high exerts a pressure of 62.5 lbs. per square foot, and a column $1''$ high will exert a pressure of $62.5 \div 12 = 5.2$ lbs. per square foot.

The horse-power required for the actual work of pumping the gas can therefore be determined by multiplying the number of cubic feet pumped per minute by the product obtained by multiplying the net pressure in inches of water by 5.2 (which gives the pressure in pounds per square foot against which the exhauster is working) and dividing the final product by 33,000. Putting this rule into the shape of a formula we have:

$$\text{H. P.} = \frac{VH \times 5.2}{33{,}000} \text{ in which}$$

$V =$ number of cubic feet of gas pumped per minute, and

$H =$ the difference between the outlet and inlet pressures in inches of water.

In the present problem

$$V = \frac{25{,}000}{60} = 416.66 \text{ and}$$

$$H = 9'' - \tfrac{1}{2}'' = 8.5 \text{ so}$$

$$\text{H. P.} = \frac{416.66 \times 8.5 \times 5.2}{33{,}000} = \frac{416.66 \times 44.2}{33{,}000} = \frac{18416.372}{33{,}000} = 0.588$$

and therefore the horse-power required for pumping the gas, without taking into consideration the friction of the exhauster or any other losses of power in the machinery, is 0.558 horse-power.

From the information obtained by a series of tests made on exhausters pumping gas into outlying holders, in which tests the amount of gas pumped, the pressure against which it was pumped and the horse-power developed in the engines doing the work were all determined, Mr. George J. Roberts works out the following formula to be used in determining the total horse-power required in any given case when the gas is to be handled with an exhauster of the Wilbraham type.

H. P. $= 0.00511 \times H \times V$, in which

$H =$ the net pressure in inches pumped against, and

$V =$ thousands of cubic feet pumped per hour.

Substituting the values of H and V in the present problem we have:

H. P. $= 0.00511 \times 8.5 \times 25 = 1.09$.

So that the total horse-power required according to this formula is nearly double that required for pumping the gas. Or, in other words, the efficiency of the engine and exhauster when working at this rate is only about 50%. (Trustees.)

8. What is the maximum amount of gas containing 2.5% of carbonic acid, CO_2, that can theoretically be purified by a bushel of unslaked lime containing 85% of calcic oxide, CaO, assuming that the weight of a bushel is 80 lbs. and that carbonic acid only is to be removed from the gas by the lime? Give all your calculations.

Ans. As the bushel of lime weighs 80 lbs. and contains 85% of CaO it will contain 68 lbs. of CaO. When the lime is slaked, hydrate is formed according to the reaction.

Lime		Water		Calcic Hydrate.
CaO	$+$	H_2O	$=$	$Ca(HO)_2$

Since the atomic weight of Calcium (Ca) is 40, that of Oxygen (O) 16 and that of Hydrogen (H) 1, the respective weights are $(40+16)+(2+16)=[40+(17\times 2)]$ or $56+18=74$. That is 56 lbs. of CaO will make 74 lbs. of $Ca(HO)_2$ and 68 lbs. of CaO will make $68 \times \frac{74}{56} = 68 \times 1.321 = 89.83$ lbs. of $Ca(HO)_2$.

The equation of the reaction between $Ca(HO)_2$ and CO_2 is:

$Ca(HO)_2 + CO_2 = CaCO_3 + H_2O$ the weights being

$[40+(17\times 2)] + [12+(16\times 2)] = [40+12+(16\times 3)] + [(1\times 2)+16]$ or

$74 + 44 = 100 + 18.$

We are only concerned with the first half of the equation, from which we see that 74 lbs. of $Ca(HO)_2$ will combine with 44 lbs. of CO_2. Therefore 89.83 lbs. of $Ca(HO)_2$ will combine with $89.83 \times \frac{44}{74} = 53.41$ lbs. of CO_2. CO_2 dry at 60° F. and 30″ barometer weighs 1 lb. for each 8.595 cu. ft., so 53.41 lbs. will be $53.41 \times 8.595 = 459.076$ cu. ft. The gas in question contains 2.5% of CO_2 or 25 cu. ft. per 1,000 cu. ft. $\frac{459\ 076}{25} = 18,363$ and 18,363 cu. ft. is the maximum amount of gas containing 2½% of CO_2 that can be purified by a bushel of unslaked lime weighing 80 lbs. and containing 85% of CaO. Of course even this result could not be reached in practice, as it is never possible to entirely saturate all the calcic hydrate with carbonic acid under working conditions, even assuming that all the other impurities that would combine with $Ca(HO)_2$ are removed by other means. (Trustees.)

9. How would you calculate the maximum temperature that can be produced by burning any given sample of gas, the oxygen for combustion being derived from the atmosphere?

Ans. The highest temperature that can theoretically be obtained by burning a gas in air is the temperature that will be reached when no heat is lost in any way, all the heat developed being employed to heat up the products of combustion and the nitrogen accompanying the oxygen drawn from the air for this combustion. These conditions are of course never obtained in practice, but, as it is very hard to measure accurately the losses that occur in practice, the maximum theoretical temperatures are used to furnish a basis for comparisons between different gases, it being assumed that the relations between the temperatures actually obtained will be very nearly the same as those existing between the theoretical temperatures, although the absolute temperatures will be very different in the two cases.

This maximum theoretical temperature evidently depends upon the quantity of heat developed by the combustion of a unit weight of the gas and upon the quantity of heat required to raise, by one degree, the temperature of the products resulting from the combustion of this unit weight and the quotient obtained by dividing the quantity of heat produced by the quantity required to raise the temperature of the products of combustion one degree will give the highest temperature that can be reached by burning the given gas. The quantity of heat produced is given by the calorific value of the gas. The amount of heat required to raise the temperature of the products of combustion one degree can be calculated by multiplying the weight of each product that is produced by its specific heat, the nitrogen mixed with the oxygen in the air and drawn into the flame with it being included. It is therefore necessary to determine what substances are produced by the combustion of the gas and the weight of each of these substances that is obtained from a unit weight of the gases, to multiply the determined weight of each substance by its specific heat and to add together the numbers obtained by these multiplications, the sum forming the divisor of the fraction.

The maximum temperature that can be produced by burning a gas in air can therefore be determined by dividing the calorific value of the gas, per pound, by the sum of the numbers obtained by multiplying the weight of each of the products of combustion produced from 1 lb. of gas by its proper specific heat, the nitrogen mixed in the air with the oxygen required for combustion being considered as one of the products of the combustion.

To illustrate by a simple example, the maximum temperature that can be produced by the combustion of carbonic oxide, CO, may be determined as follows:

1 lb. of CO requires for its combustion to carbonic acid, CO_2, 0.571 lb. of oxygen, which will have mixed with it in the air $0.571 \times 3.31 = 1.89$ lbs. of nitrogen, N, and the products of the combustion of 1 lb. of CO will therefore be 1.571 lbs. of CO_2 and 1.89 lbs. of N. The calorific value of CO is 4383 B.T.U. per pound, the specific heats of CO_2 and N are respectively 0.217 and 0.244 and the equation for the maximum temperature in degrees Fahrenheit is,

$$T = \frac{4383}{1.571 \times 0.217 + 1.89 \times 0.244} = \frac{4383}{0.802} =$$

5465° F. (Trustees.)

10. Describe some method of making iron oxide to be used for the removal of sulphuretted hydrogen from gas during its purification.

Ans. The iron oxide, or sponge, as it is sometimes called, which is used for removing sulphuretted hydrogen from gas is prepared by thoroughly oxidizing or rusting iron in the shape of borings and mixing it with planer chips so as to make the material more permeable by the gas. To produce a good material, the iron must be present in sufficient quantity, must be thoroughly oxidized into the hydrated sesqui-oxide, and must be uniformly distributed throughout the planer chips.

The iron should be in the shape of cast iron borings, the finer the better, and should be used in the proportion of from 20 lbs. to 25 lbs to each bushel of planer chips. The chips should be clean and free from dust. To prepare the material, the desired number of bushels of planer chips are measured out and spread to a depth of about 18″ on a floor preferably paved with brick or cement, and are then sprinkled with water, turned, again sprinkled and turned, and so on until the whole mass is uniformly wet, but not soggy. This wetting of the chips is for the purpose of causing the particles of iron to adhere to them. An amount of iron borings equal to 5 lbs. per bushel of chips used is then weighed out, spread evenly over the top of the wet chips and mixed with them by turning the mass and wetting it while it is being turned. This operation is repeated until the whole amount of iron to be used has been added and is mixed evenly throughout the mass, which on the last turning is brought up to a depth of 24″.

The iron by this time should have begun to oxidize rapidly and the heat produced by this oxidation will cause the mass to grow quite hot. To prevent the temperature from becoming excessive as well as to expose fresh surfaces of the iron to the oxidizing influence of the water and the air the mass must be turned and wet at comparatively short intervals. It may at first have to be turned every ten or twelve hours, but as the oxidation of the iron becomes more complete the heating will not be as rapid and the interval can be made longer. The wetting and turning must be continued until all the iron is thoroughly oxidized, the attainment of this condition being shown by the cooling down of the mass, by the changing of the color to a reddish brown, and by the absence of any particles of unoxidized iron as determined by a close inspection of the mass. During the several turnings care must be taken to break up all the lumps found, since the iron in the interior of such lumps cannot be acted upon by the air and the water. When the oxidation is complete the chips should all be covered with oxide, and should not adhere to each other.

Brine and ammoniacal liquor are sometimes used for wetting the chips and the iron instead of water, the oxidation of the iron being hastened by their use. Sawdust is also sometimes used in place of planer chips, the argument in its favor being that there is less loss of oxide by its blowing away as dust during the handling of the material when in use than occurs when the chips are employed. The oxide made with chips does not, however, pack as tightly in the purifiers as does that made with sawdust, and therefore does not throw as much pressure, and the majority of engineers prefer oxide made with them to that made with sawdust. (Trustees.)

11. What is meant by the statement that a gas is saturated with vapor at a certain temperature and pressure?

Ans. A gas is said to be saturated with vapor at a certain temperature and pressure when it contains the full amount of vapor that it can carry under these conditions. When a gas is so saturated it cannot be made to take up any more vapor unless its temperature is increased or its pressure reduced, and any increase of pressure or decrease of temperature will cause the condensation into the liquid state of a portion of the vapor. At any given temperature and pressure a definite quantity of any given vapor is required to saturate a gas, and this quantity is always the same for the same conditions. (Trustees.)

ANSWERS TO FIRST SERIES OF QUESTIONS, 1901—THIRD SECTION—PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

Answers to questions Nos. 3, 4 and 12 have been published in previous volumes of the Proceedings, and can be found there, as follows:

No. 3, Vol. XVI, page 80.
No. 4, Vol. XIII, page 39.
No. 12, Vol. XVII, page 58.

The answers to the other questions are as follows:

1. What are the respective advantages and disadvantages of anthracite coal, gas coke, and furnace coke when considered with reference to their use as the fuel in the generator of a carburetted water gas apparatus?

Ans. Anthracite coal will contain less ash than gas coke and will therefore make less clinker than such coke. Since it is much denser than coke a given generator volume will hold a greater weight of fuel when coal is used and this fuel will neither heat up nor lose its heat as rapidly as coke. This permits of longer "runs" and "blows" and so reduces the percentage borne by the time required for opening and closing the valves in putting on and taking off the runs, to the total time during which the machine is in operation. With coal there is also the further advantage that the generator does not have to be opened as often for charging as is necessary with coke.

On the other hand the surface presented to the action of the blast and steam is smaller with anthracite coal than it is with gas coke, owing to the porous nature of the latter. The irregular form and roughness of the surface of the individual pieces of coke keep the fuel bed in a condition favorable for the general and intimate contact of both blast and steam with the carbon of the fuel. The heat can therefore be gotten up quickly and gas made at a rapid rate during the shorter run, and with quick workmen the increase of time required for handling the valves owing to the shortness of the blows and runs is not of great importance. It is, however, necessary when using gas coke to be very careful not to unduly prolong either the blows or the runs, since, owing to the rapidity with which coke is consumed, any over blowing increases the fuel account very greatly, while any extra length of run increases the amount of carbonic acid in the gas very rapidly, since the fire cools off quickly.

In general it is probably true that fair results as to the quantity of fuel used per 1,000 cubic feet of gas and the quality of the gas made can be secured more easily with coal than with gas coke, but that given good management and the necessary supervision to ensure the proper handling of each kind of fuel there is little, if any, choice between the two materials.

Furnace or oven coke unless it is made from carefully washed coal, or from coal that is orginally free from ash, such as that used in making Connellsville coke, is apt to contain more ash than gas coke and to give trouble from clinker. It does not possess the density of anthracite coal nor is it as porous as gas coke. The 48-hour or soft coke makes a better generator fuel than does the 72-hour or hard coke. Opinions differ as to the relative merits of furnace coke and gas coke, some engineers preferring gas coke and others furnace coke under similar conditions.

Given the proper handling of each, there is, however, little difference between the three classes of fuel, and even slight differences in the prices or local conditions will be sufficient to turn the scale in favor of one or the other. (Trustees.)

2. After having heated up and put into regular operation a bench of retorts, full depth regenerative setting, how would you proceed to adjust the chimney dampers and primary and secondary air slides in order to secure the greatest fuel economy?

Ans. When a bench of retorts with a full depth regenerative setting has been heated up to the required heat and put into regular operation the proper conditions for economical running are obtained as follows: The chimney dampers are pushed in, until, on opening the charging door of the furnace and throwing into the fire a handful of coal dust, the resulting flame plays lazily back and forth out of the door, being neither drawn steadily in by the draft nor forced out too vigorously by an excess of pressure. If the heat can be maintained with a slight pressure on the furnace great economy of fuel can be attained, but, as a rule, heats cannot be kept up unless the pressure is cut down practically to zero. There should never be a decided "pull" on the furnace except on special occasions, when the heat has to be brought up quickly, without regard to the quantity of fuel used. The dampers set, the heat is brought to the proper point by increasing or decreasing the primary air opening, the secondary air being kept properly proportioned to the amount of carbonic oxide produced by the furnace. The proper amount of secondary air opening is determined by noting the disappearance in the take-off flue, or at any convenient point of observation in the waste gas flues of the recuperators where the heat is not too high, of the blue flame that indicates the escape of unconsumed carbonic oxide from the combustion chamber. If this flame is present the secondary air opening is gradually increased until the flame disappears, waiting a sufficient length of time after each slight increase of opening for the extra air to travel through the bench. When the flame is gone the adjustment is right and the secondary air slides should be clamped. If no flame is present and the adjustment has not been made for some time, the secondary air openings are decreased until the flame appears, and then the adjustment is made as above. As the quantity of carbonic oxide produced varies with the condition of the fire as to the amount of ashes, depth of fuel-bed, etc., the secondary air supply cannot be kept exactly right for every hour of the day, and, this being so, enough is supplied to consume the average maximum production of carbonic oxide, since the loss of heat due to the small excess of secondary air present when less carbonic oxide is made, is smaller than would be suffered by allowing an equal quantity of carbonic oxide to escape unconsumed, the loss of sensible heat being practically equal in both cases, while with the unconsumed carbonic oxide there is the additional loss of its heat producing power. If there is sufficient recuperating surface in the bench, the appearance in the recuperators below the point of entrance of the secondary air of any heat above a dark red is an almost certain indication of an insufficient secondary air supply, even though no flame can be seen, the flame not being very marked in a highly heated space.

After this adjustment of the damper and air slides is made, they are fastened so securely that it is impossible for them to be moved unintentionally.

Regenerative benches will not give the best results, nor the highest heats, unless the adjustments spoken of above are properly made, and the making of them should not be left entirely to the average retort house fireman, nor even to the average foreman, until he is taught enough of the principles of generator firing to have some insight into what he is trying to do. Even then regular investigation by the Superintendent of the conditions of damper opening and air supply will tend to keep down the percentage of fuel used. (Trustees.)

5. Give in British thermal units the heating power of a pound and of a cubic foot of each of the following gases:

Hydrogen	H
Methane or Marsh Gas	CH_4
Ethylene or Olefiant Gas	C_2H^4
Carbonic Oxide	CO
Acetylene	C_2H_2

Ans.

		Per Pound.	Per Cubic Foot.
Hydrogen	H	62,100	328
Marsh Gas	CH_4	23,636	1,016
Olefiant Gas	C_2H_4	21,898	1,621
Carbonic Oxide	CO	4,383	325
Acetylene	C_2H_2	21,856	1,502

The figures given by different experimenters for the heating powers of these gases vary, as do the weights of a cubic foot of the gases, and therefore the figures for the heating power per cubic foot vary also. Thus Newbigging quoting from Letheby gives the following figures for the heating power per cubic foot:

H	329
CH_4	996
CO	320
C_2H_2	1,251

and the Committee on Education, quoting from Julius Thomsen, gave for the same gases:

H	325·5
CH_4	1,022.8
CO	324·7
C_2H_2	1,493·4

The values first given above are based on the determination of calorific power made by Berthelot as given in Poole's Calorific Power of Fuels and the weight of gases calculated from the weight of air as determined by Regnault and afterwards corrected for slight errors.

The figures given above are in each case those for the gross or total heating power. In the case of hydrogen and gases which contain hydrogen as one of their constituents, a distinction must be made between the gross or total heating power and the net or available heating power. The combustion of such gases produces water, a substance which while liquid at ordinary atmospheric temperatures is a vapor at the temperatures at which the products of combustion escape under the ordinary conditions of the combustion of gases. To convert a pound of water from the liquid state to that of vapor at 212° F. 966 heat units are required. Since each pound of hydrogen burns to 9 lbs. of water, there will be a difference of $9 \times 966 = 8{,}694$ heat units for each pound of hydrogen contained in the combustible gas between the total heat of combustion as estimated by a calorimeter, in which the water is condensed to the liquid form and the heat required to vaporize it set free and measured, and the net heat or heat available when as in ordinary combustion the water escapes in the form of vapor. If, therefore, the total heating power of hydrogen as determined by the calorimeter is 62,100 heat units, the net heating power, when the water escapes in the form of vapor at 212° F., will be 62,100—8,694=53,406 heat units. In the same way knowing the percentage of hydrogen contained in each of the hydrocarbon gases of which the gross heating power has been given we can determine the net heating power, assuming the water vapor to escape at 212°, and the figures so determined are given below. In figuring on problems of combustion under working conditions in which fuels containing hydrogen are used, the net heating power should always be employed to arrive at the true results.

		Per Pound.	Per Cubic Foot.
Hydrogen	H	53,406	282
Methane or Marsh Gas	CH_4	21,463	908
Ethylene or Olefiant Gas	C_2H_4	20,657	1,529
Acetylene	C_2H_2	21,229	1,459

(Trustees).

6. What is the effect of heat upon the volume of any given weight or quantity of gas, and what bearing has this effect upon the question of the measurement of gas?

Ans. The volume of a given weight of gas, that is the space occupied by the quantity of gas possessing this weight, is increased when the temperature of the gas increases, and is decreased when the temperature decreases. It has been found by careful and accurate measurement that the exact amount of this increase or decrease is 1/273 part of the volume of the gas at 0° C. for each change of 1° C. in the temperature. This is equivalent to an increase of $\frac{1}{273 \times 1.8} = \frac{1}{491.4}$ (or as it is usually taken 1/492) part of the volume at 32° F. for each change of 1° F. in the temperature of the gas. The rule is sometimes given approximately as being, that the volume increases 1% of the original volume for each increase of 5° F. in the temperature, the original volume being measured at the temperature, whatever it may be, that it may happen to possess. But for accurate work it is necessary to remember that the increase in volume for an increase in temperature of 1° F. is not the $\frac{1}{491.4}$ part of the volume at any temperature, but only that part of the volume at 32° F. It must also be borne in mind that this rule applies only to dry gas, that is gas perfectly free from moisture.

Since according to the above law the same weight or quantity of gas possesses very different volumes at different temperatures, it follows that in order to obtain proper comparisons between amounts of gas measured under different conditions of temperature, it is necessary to know the temperature at which the gas is measured in each case. Thus if the temperature of the gas as it passes through the station meter of a gas works varies considerably, either with the seasons or from any other cause, the working results will apparently be poorer when the temperature at the meter is low than they will when this temperature is high; though actually the reverse might be the case. Therefore in order to obtain accurate figures for comparison it is necessary that the average temperature of the gas at the station meter be determined from the temperatures obtained by frequent observation, and that the volume of the gas as measured at these temperatures be reduced to the corresponding volume at a standard temperature, which is usually taken as 60°, and the working results calculated from this corrected volume. This correction of volume for temperature is also necessary if accurate information is to be obtained as to the actual amount of gas lost by leakage in the distributing system, since if the temperature at the station meter is high and that at the consumers' meters low and no correction is made, the amount of gas unaccounted for will be much higher than the actual loss by leakage. (Trustees.)

7. How much pure ammonia gas (NH_3) is contained in a gallon of ammoniacal liquor which has a strength of 10 oz ?

Ans. Since according to the answer to question No. 7 of the Fourth Series for 1900 an ammoniacal liquor which has a strength of 10 oz. contains per gallon a quantity of ammonia (NH_3) sufficient to saturate 10 oz. of pure sulphuric acid (H_2SO_4), or in other words to combine with this amount of acid to form sulphate of ammonia ($[NH_4]_2SO_4$), the quantity of ammonia in a gallon of such liquor can be readily calculated from the combining weights of ammonia and sulphuric acid. The combination of these two substances to form sulphate of ammonia takes place according to the reaction $2\ NH_3 + H_2SO_4 = (NH_4)_2SO_4$, and since the atomic or combining weights of the elements entering into the reaction are:

Hydrogen	(H)	1
Nitrogen	(N)	14
Oxygen	(O)	16
Sulphur	(S)	32

$2(14 + 3) = 34$ parts of ammonia (NH_3) combine with $2 + 32 + 64 = 98$ parts of sulphuric acid (H_2SO_4) or 1 oz. of H_2SO_4 will saturate or combine with $\frac{34}{98} = .3469$ oz. of ammonia, and 10 oz. of H_2SO_4 will combine with $.3469 \times 10 = 3.469$ oz. of NH_3.

Therefore a gallon of ammoniacal liquor of 10 oz. strength will contain 3.469 oz. of pure ammonia. (Trustees.)

8. What is the minimum size of pipe which it is considered advisable to use for services for ordinary dwelling houses? Give the reasons for your answer.

Ans. It is not considered good practice to use any pipe smaller than 1″ for the services for ordinary dwelling houses which are within 40 feet of the street main, nor pipe smaller than 1¼″ when the house is more than 40 feet from the main, and some engineers never use any pipe smaller than 1¼″ even for shorter services.

The extra cost of the larger pipe is not a large percentage of the total cost of the service, while the use of such pipe provides for a possible increase in the amount of gas required, a provision which is especially necessary at the present time in view of the great development now going on in the sales of gas for fuel purposes. The use of the larger size of pipe also prevents trouble from any slight settlement of the service or from partial stoppages due to any other causes. A small amount of water, naphthalene or other deposit that would hardly be noticed in an 1¼″ pipe would seriously affect the flow of gas through a ¾″ pipe, and the extra first cost of the larger pipe is thus often offset by the saving effected by having fewer stopped services to deal with. The extra thickness of the larger pipe also gives it a longer life, especially if the pipe used for services is not coated before being laid. This longer life reduces the cost of service repairs. As will be seen by reference to the pipe cards the difference in thickness between ¾″ and 1¼″ pipe is 24% of the thickness of the smaller pipe.

The use of the larger pipe thus provides against the necessity for enlarging the service when a gas range or water heater is installed and also reduces the cost of maintenance and renewals. (Trustees.)

9. Flat flame burners are of two kinds, known respectively as fishtail and batswing burners. Give a description of each kind,

and state which will give the greatest amount of light from a given illuminating gas, the gas being consumed under the proper conditions to give the best result in each case.

Ans. Fishtail and batswing burners differ in the form of the tip and of the orifices in the tip from which the gas issues.

In the fishtail burner the top of the tip is usually concave, though in the poorer forms the tip has a flat top. The gas issues from the tip through two circular orifices set opposite each other. The axes of these orifices are set at an angle with each other so that the jets of gas meet and by the force of their impact are spread out into a sheet of flame in a plane midway between the orifices and at right angles to the line drawn through their centers. The shape of the flame produced by a fishtail burner is affected by the angle between the axes of the orifices through the tip, a very acute angle producing a long and narrow flame which is widened and shortened as the angle is made more and more obtuse. The determination of the angle at which the greatest illuminating power per cubic foot of gas is produced is an important point in the design of a fishtail burner, as is also that of the proper size of orifice, since to secure the maximum results it is necessary to use different angles and sizes of orifice with different qualities of gas.

The tip of the batswing burner has a dome shape top, varying from a hemisphere, or even a shape approximately ¾ of a sphere, to a very flat dome. The gas issues through a single orifice, which is a narrow slit cut through the top of the dome to its lower edge and at right angles to its base. The gas issues from this slit in a sheet, the thickness of which is varied to suit the quality of the gas to be consumed, being thin for rich gases and thick for poor gases. There is little difference at present between the shape of the flame produced by the fishtail and batswing burners respectively, although as they were first designed the fishtail burner gave a long narrow forked flame and the batswing a short broad flame, whence the names.

Since it is necessary that the two circular jets in which the gas issues from a fishtail burner should come together with considerable velocity if the gas is to be well spread out and a good flame produced, this form of burner requires a higher pressure at the tip than is needed with a batswing burner and consequently the latter as a rule yields more light per cubic foot of gas than does the former when both are being worked under the proper conditions for the attainment of the best results. The fishtail burner is, however, much less apt to stop up than the batswing and for this reason is given the preference by most gas companies, if any trouble is experienced from burner stoppages. (Trustees.)

10. Describe some economical form of gas water heater for use in connection with the ordinary kitchen boiler.

Ans. One of the best forms of gas water heater for use in connection with a kitchen boiler is made in the shape of a cylinder, from 7″ to 10″ in diameter and 27″ to 30″ high, which is suspended by the side of the boiler by means of the water pipes. (With the larger sizes the cold water pipe is extended down to the floor to give greater strength but this is not necessary with the smaller sizes.)

A cylindrical casing made of two concentric jackets of sheet steel, lined with asbestos and separated by an annular air space, encloses the burner and the water pipes and chamber. This casing is partially closed at the bottom by the burner and is covered at the top, the flue opening being in the centre of the cover.

The burner is an atmospheric ring burner capable of consuming from 30 to 60 cu. ft. of gas per hour, according to the size of the heater.

The cold water pipe comes in from the bottom through the centre of the burner and passing to the top of the cylinder is screwed into the cold water compartment of a double water chamber. Into the lower side of this compartment a number of small tubes are screwed, being placed at equal distances apart around the circumference of a circle. Each tube is open at the lower end and is enclosed in a pipe (¾″ to 1″ in diameter) capped at its lower end and having the other end screwed into the bottom of the hot water compartment of the water chamber. A pipe leads from the side of this compartment to the top of the boiler.

The cold water entering by the central pipe passes up to the cold water compartment of the water chamber, then down through the small tubes nearly to the bottom of the cylinder and then up through the annular spaces between the tubes and the pipes enclosing them to the hot water compartment of the water chamber, whence it flows through the delivery pipe to the top of the boiler.

The hot products of combustion pass up the interior of the cylinder entirely surrounding the water pipes, which are thus exposed to the full effect of the heat produced by the combustion of the gas, and going around the water chamber pass out to the chimney. As the water flows in thin streams through the annular spaces in the pipes it is quickly heated, and this form of heater is both effective and economical.

Care must be taken to keep the flame from impinging on the lower ends of the water pipes, since if it does the combustion of the gas is checked and rendered incomplete and gas will be wasted. (Trustees.)

11. What is meant by the term "light" used in designating the size of meters? Is its value the same in small meters, such as 3-lights, as in large meters, such as 100-lights?

Ans. The term "light" used in designating the size of gas meters is a conventional term which is supposed to indicate the number of lights or burners the consumption of which the meter is capable of supplying. It does not, however, afford an exact indication of the amount of gas which may be passed through the meter without overloading it, since its value expressed in the quantity of gas that may be delivered varies very much with the size of the meter. Thus a 3-light meter can easily supply 50 cubic feet per hour, so that in this case the value of a light is nearly 17 cubic feet per hour. A 100-light meter should not be called upon to pass more than 600 cubic feet per hour, which makes the value of the light for this size of meter only 6 cubic feet per hour. The value of a light is therefore not the same in small meters as in large meters. (Trustees.)

Answers to First Series of Questions, 1901—Fourth Section—Practical Class—American Gas Light Association.

Answers to all these questions, except Nos. 8, 10 and 11, have been published in previous volumes of the Proceedings, and can be found there as follows:

No.	1,	Vol.	XVII,	page	71.
"	2,	"	XVII,	"	72.
"	3,	"	XVII,	"	73.
"	4,	"	XVII,	"	74.
"	5,	"	XVII,	"	75.
"	6,	"	XVII,	"	74.
"	7,	"	XVII,	"	75.
"	9,	"	XVII,	"	77.
"	12,	"	XVII,	"	78.

The answers to questions Nos. 8, 10 and 11, are as follows:

8. How does a suction pump "draw" water? Why and how does a hot chimney "draw?"

Ans. A suction pump being provided with a piston and two valves, one in the piston and the other at the point where the suction pipe enters the cylinder, which valves are set in such a manner as to cause water or air to be pushed out of the delivery pipe of the pump and to permit water to enter from the suction pipe into the space below the piston during the up stroke, and also to permit water to travel through the piston from below upwards while preventing any flow of water from the cylinder back into the suction pipe during the down stroke of the piston, such a pump "draws" water by the forcing out from the cylinder of the water, or air, in the space above the piston as this is raised, and thus, by decreasing the amount of water, or air, left to fill the original space, reducing the pressure in the lower part of the cylinder and in the suction pipe below that exerted by the atmosphere. The surface of the water outside the suction pipe being, therefore, subjected to a higher pressure than the surface inside this pipe, water is pushed into the pipe and through it into the cylinder of the pump to a height above the outside level dependent upon the amount by which the action of the piston reduces the pressure in the pipe and cylinder below the outside pressure. This pressing up of the water continues as long as the pump is working and delivering water, the space occupied by the water thrown off by each stroke of the piston, being filled by water forced in by the excess of pressure on its outer surface. The water is thus moved, not by a pulling force, as is implied by the commonly accepted way of describing the working of a suction pump by saying that it "draws" water, but by a pushing force, each molecule of water being moved along because the pressure behind it is greater than that in front of it.

In the same way the draft of a chimney is caused by a difference of pressure at the base of the chimney, due to the difference between the weight of the column of hot air and products of combustion in the chimney and that of a column of cold external air, of equal height and cross section. The contents of a chimney being all cold, there is no tendency of the air, or the gas within it, to rise or fall. The contents being heated, either from the warm sides of the chimney, or otherwise, expand. A portion of them, by this act of expansion, are forced out of the chimney; the rest of the contents, being expanded, are lighter, by the weight of the amount forced out, than the surrounding atmosphere, and will be displaced by the heavier air pressing for admission, at the base of the chimney. A flow through the chimney is thus established, and will be maintained as long as the pressure of the atmosphere at the base of the chimney is greater than the downward pressure of the contents of the chimney. (Trustees.)

10. What is the commonly accepted theory as to the cause of the luminosity of the flame produced by burning illuminating gas in a luminous burner?

Ans. The principal cause of the luminosity of the flames produced by burning illuminating gas in ordinary burners is believed to be the heating to incandescence before they meet with sufficient air for their combustion of minute particles of solid carbon formed within the flames. It is thought that these carbon particles are produced by the decomposition of the hydrocarbons in the gas which results from their exposure, while in the interior of the flame and out of contact with air, to the heat produced by the combustion, on the surface of the flame, of the hydrogen, marsh gas and carbonic oxide. As the carbon is set free from chemical combination with another element, or, as it is called, is "nascent" in the flame, the particles are really molecules of carbon many times finer than any particles that can be produced by mechanical subdivision and therefore are readily heated to incandescence by the heat of the flame and as readily consumed when they come in contact with air.

Under this theory the amount of light given by a flame will depend largely upon the quantity of carbon set free in the flame and upon the temperature to which the particles of carbon are heated before they are consumed. In practice it is found that the greatest illuminating value per cubic foot of gas is given by flames when they are just on the point of smoking and also that anything which tends to raise the temperature of the flame increases the light given, other things being equal.

It will be noticed that the presence of carbon particles is spoken of as the principal, but not the sole, cause of luminosity in the flames produced by the combustion of illuminating gas. This is because a portion of the light yielded by such flames is derived from the combustion at the high temperature existing in them, of marsh gas and of some of the heavier hydrocarbons before they are decomposed. An increase in the temperature of a flame increases the amount of light produced in this way as well as that derived from the incandescence of the carbon particles.

Quite a full discussion of the facts and reasoning upon which the solid particle theory of the luminosity of illuminating gas flames is based will be found in the first of a series of lectures upon Gaseous Illuminants delivered by Prof. V. B. Lewes, and published in the American Gas Light Journal Vol. 53, page 877 and in the Journal of Gas Lighting, Etc., Vol. 56, page 1140. (Trustees.)

11. Why is the flame of a Bunsen or atmospheric burner non-luminous?

Ans. The flame of a Bunsen or atmospheric burner is non-luminous because such a flame contains none of the carbon particles, the raising of which to incandescence furnishes the greater part of the light produced by a luminous flame, as is explained in the answer to question No. 10. The absence of carbon particles from the atmospheric flame is considered to be due to the chemical activity of the oxygen mixed with the gas before combustion in burning up the hydrocarbons before they can be decomposed; to the diluting effect of the nitrogen which raises the temperature that must be reached before the hydrocarbons decompose; and also to the cooling effect of the air which acts in the same way as the diluting effect and adds to the general result, although when the proportion of air to gas is high, above 3 to 1, the cooling is less than the increase in temperature due to more rapid oxidation. "In an ordinary atmospheric flame the nitrogen and oxygen are of about equal importance in bringing about the loss of luminosity, but if the quantity of air be increased the oxidation becomes the principal factor, and the nitrogen practically ceases to exert any influence." (Trustees.)

SECOND SERIES OF QUESTIONS, 1901—SECOND SECTION—PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

1. What are the respective merits of concrete and brick work as the material to be employed in the construction of the walls of gas holder tanks?

2. State the nature of the material to be employed and the

points of valve design that should be observed in the pump end of a steam pump for handling tar.

3. Describe some method by which accumulations of naphthalene may be completely removed from the inlet pipes of gas holders.

4. Describe, with sketches, the proper manner in which to make the feed-water and blow-off connections for steam boilers, and state the faults that are to be guarded against in making such connections.

5. Describe the proper treatment of iron oxide from the time it is taken out of the box for revivification until it is again returned to the box.

6. What is the maximum amount of gas containing 0.85% by volume of H_2S that can theoretically be purified at one exposure by a bushel of iron sponge, or mass, which contains an amount of $Fe_2O_3 . H_2O$ equivalent to a weight of 25 lbs. of iron? It is assumed that no oxygen is present in the gas. (Give the reaction, or reactions, upon which you base your figures, and also give your calculations.)

7. Calculate the maximum theoretical flame temperatures that can be produced when Hydrogen, H, Marsh Gas, CH_4, and Olefiant Gas, C_2H_4, are burnt in air.

8. What effect does the saturation of a gas with one vapor have upon the amount of other vapors that can be carried by the gas?

9. What is meant by "The Mechanical Equivalent of Heat," and what is its value expressed in foot pounds per heat unit (British thermal unit)?

10. The amount of gas unaccounted for during distribution is expressed sometimes as a percentage of the quantity made and sometimes in terms of the number of thousand cubic feet unaccounted for per mile of main per year. Which method of expression furnishes the best indication of the condition of the distributing system and the best basis for comparisons between different companies and different periods in the history of the same company?

11. Describe some method of coating wrought iron pipe, such as is used for services, or some other way by which this pipe can be protected from corrosion.

12. What is the so called "Otto cycle" in gas engines?

(Answers to these questions are due June 22nd.)

SECOND SERIES OF QUESTIONS, 1901—THIRD SECTION—PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

1. Name and describe the three grades of oil which are commonly used as the carburetting material in the manufacture of carburetted water gas.

2. Describe the operation of a direct fire furnace used for heating coal gas retorts, paying especial attention to the way in which the fire should be handled to secure the most economical results.

3. Give a description illustrated with sketches, of one length of hydraulic main for benches of six retorts, including the dip pipes, overflow or overflows, arrangements for cleaning out heavy tar or pitch, and the considerations that determine the area of the surface of liquor in the main outside of the dip pipes.

4. Describe one, or more, of the various methods of construction that are employed to reduce to a minimum the damage resulting from an explosion in the blast pipe of a water gas apparatus, and explain how they act.

5. An illuminating gas has the following composition by volume:

Carbonic acid	CO_2	2.7%
Oxygen	O	0.7%
Heavy Hydrocarbons		12.8%
Carbonic oxide	CO	30.7%
Hydrogen	H	32.4%
Marsh Gas	CH_4	13.9%
Higher Paraffins	C_nH_{2n+2}	2.4%
Benzene Vapor		0.6%
Nitrogen		3.8%

Calculate the heating power per cubic foot, assuming the heavy hydrocarbons to be Olefiant Gas ($C_2 H_4$), and the higher parafins to be Ethane ($C_2 H_6$). Calculate both the gross and the net heating power as explained in the answer to question No. 5 of the first series for 1901.

6. Give the formula by which the volume, measured at any pressure and temperature, of a gas saturated with moisture can be corrected to the standard conditions of a temperature of 60° F. and a pressure of 30″ of mercury, and explain the manner in which this formula is derived.

7. What are the different methods employed to determine the quantity of ammonia contained in ammoniacal liquor and consequently the value of the liquor, and which gives the most accurate results?

8. In making meter connections the swivel of the meter union is by some inserted in the end of the lead pipe, the axes of pipe and swivel coinciding, while by others it is inserted in an opening made in the side of the pipe with its axis at right-angles to that of the pipe. State, with the reasons for your answer, which method you consider best.

9. What are the different standard sizes of consumers' meters, and how many burners, each consuming 6 cubic feet per hour, will each size of meter supply?

10. Describe an Argand gas burner and state how it compares in efficiency from a light giving standpoint with flat flame burners.

11. What are the relative carrying capacities for gas of a 3″ main, a 4″ main, and a 6″ main, the conditions as to length of main, pressure lost by friction and specific gravity of the gas being the same in each case?

12. What are the characteristics of a good building brick, and how can a brick be tested to determine whether or not it possesses these characteristics?

(Answers to these questions are due June 15th, 1901.)

SECOND SERIES OF QUESTIONS, 1901—FOURTH SECTION—PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

1. Give the meaning of the terms "run of mine," "¾ inch," and "1½ inch" as applied to bituminous coal, and state, with your reasons for the statement, which class of coal gives the best carbonizing results.

2. Name the principal shapes of cross-section that have been adopted for clay gas retorts and give a sketch of the cross-section which you think the best. Show on the sketch the principal dimensions of the cross-section and the thickness of the retort walls. Give the reasons for your choice.

3. Describe, somewhat in detail, the starting of a fire in, and the heating up to a working heat of a carburetted water gas apparatus of the generator-superheater type, and the putting on, making and taking off of the first run.

4. The weight of a cubic foot of dry air at 60° F. and 30″ barometric pressure is .076357 lb. The specific gravity of each of the gases named below is set opposite its name. Calculate the weight of a cubic foot of each gas at 60° F. and 30″ pressure.

Methane or Marsh Gas	CH_4	0.55408
Ethylene or Olefiant Gas	C_2H_4	0.96964
Ethane	C_2H_6	1.0389
Carbonic Oxide	CO	0.96964
Carbonic Acid	CO_2	1.5237
Oxygen	O	1.10816
Nitrogen	N	0.96964
Hydrogen	H	0.06926

5. A stand pipe 100 ft. high is filled with a gas which is lighter than air. The pipe is rigidly and hermetically sealed so that there is no communication between the air outside and the gas inside. Will the absolute pressure of the gas be the same at the top and at the bottom of the pipe? If the pressure is not the same at which point will it be greater? Give the reasons for your answers.

6. What is meant by the atomic or combining weight of a substance? What use is made of this weight?

7. What is the unit used in Great Britain and America for measuring and expressing the illuminating value of gas, and what is the value of this unit?

8. What considerations determine the depth at which street mains should be laid, there being no question of interference with any other pipe systems?

9. Describe, with a sketch showing all the dimensions of drip and cover and the arrangement of the pumping pipe, a 6″ line drip.

10. Under what conditions must gas be burnt in luminous flame burners to secure the greatest possible yield of light?

11. Why are Bunsen or Atmospheric burners used in gas cooking stoves and incandescent gas lights? Why are they not used in the ordinary cylindrical gas heating stoves and gas radiators?

12. What is Rosendale or Utica cement, how is it made, and what tests should be applied to any given sample to determine its quality?

(Answers to these Questions are due June 1st, 1901.)

ANSWERS TO SECOND SERIES OF QUESTIONS, 1901—SECOND SECTION—PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

Answers to questions Nos. 5 and 9 have been published in previous volumes of the Proceedings, and can be found there as follows:

No. 5, Vol. XVI, page 55.
" 9, Vol. XVI, " 59.

The answers to the other questions are as follows:

1. What are the respective merits of concrete and brick work as the material to be employed in the construction of the walls of gas holder tanks?

Ans. As a material to be employed in building the walls of gas holder tanks, concrete possesses the following advantages over brick work. Its tensile strength is greater and can moreover be easily increased by embedding in the tank wall, as it is built up, rings of hoop iron which may be placed from four to six inches apart horizontally and from five to six feet apart vertically. This greater tensile stength reduces the liability of cracking when the nature of the soil is such as to make it difficult to secure a good earth backing for the wall. A tank can be built of this material without the aid of any but comparatively unskilled labor under proper supervision. It can be made watertight of itself, by the use of materials free from loam or dirt and the exercise of proper care in mixing and placing in position, while it is almost impossible to build a brick wall that will be watertight of itself, and in any case the concrete tank can be made tight either by a backing of clay puddle or by rendering with cement as easily as can the brick tank. As a general thing concrete is cheaper than brick work and this is especially the case when cheap broken stone or gravel, or an accumulation of old retort material or bricks are available for aggregate. Well made concrete is not as much affected by exposure to the weather as is even the best brick work and therefore a concrete tank will not be subject to as much wear at the water line as a brick one. Altogether, unless bricks are cheap and the material for the aggregate of concrete dear, concrete is the best material to use for the walls of holder tanks, where the conditions are such as to permit the economical construction of a masonry tank.

Concrete is used for tank walls much more frequently in England than in this country. Mr. N. H. Humphrys, writing of Large Gas Holders in England (American Gas Light Journal, Vol. LXX, May 29, 1899, page 803) says: "The next direction in which progress has been made is the substitution of cement concrete for brick work, which means a large saving both of material and labor, together with increased strength. Concrete is not only easy of erection, requiring no skilled labor, but it is also stronger than brick. It offers every facility for the incorporation, within its substance, of iron bands, and concrete strengthened with iron ties, is in some respects a perfect material. The iron being enclosed is preserved from corrosion or changes of temperature, and we have the weight and rigidity of the masonry tank, combined with the strength of the iron tank, without the inelastic brittleness of the one and the contraction and expansion of the other. Gas works are continually producing large quantities of hard clinker, broken brick, old retorts, etc., that are very suitable for aggregate, but which only realize low prices if offered for sale. By exercising a little foresight, sufficient material can be saved up in the course of a few years to supply all that is wanted." (Trustees.)

2. State the nature of the material to be employed and the points of valve design that should be observed in the pump end of a steam pump for handling tar.

Ans. All the parts of the pump end of a steam pump for handling tar should be made of iron since the ammoniacal liquor, more or less of which is always mixed with the tar, would rapidly eat away any brass or composition which might be used for the cylinder lining or the valves.

The principal points of valve design to be observed are that the valves should afford full, free openings, and that the seats should be so arranged that no lumps of heavy tar or of solid matter in the tar will lodge on them and prevent the valves from closing tightly. A hinged valve is better than the ordinary form of pump valve, since in the latter form the center guide obstructs the opening to a great extent, while the hinged valve affords a free and unobstructed opening. These valves are sometimes used with horizontal seats and sometimes with seats inclined at an angle of 45°. With the inclined seat there is less danger of any solid matter remaining on the seat and keeping the valve open.

A firm which handles a great deal of tar employs pumps in which the valves are hinged and the seats horizontal, and say that they have found them to give good satisfaction. In this case the valves are not provided with springs, being prevented from opening too far by stops and being closed by their own weight as soon as the pressure is removed from beneath them. In other pumps, springs are used with the same kind of valves to keep them from opening too far and to assist in closing them promptly when the plunger changes the direction of its travel. These springs should be made of iron or steel. (Trustees.)

3. Describe some method by which accumulations of naphthalene may be completely removed from the inlet pipes of gas holders.

Ans. Accumulations of naphthalene in the inlet pipes of gas holders occur most frequently in that portion of the pipe which passes down under the tank wall and up inside the holder. When the naphthalene exists in the pipe as a flocculent lining of approximately uniform thickness throughout a large portion of its length it can be removed by charging the gas with the vapor of light naphtha, gas so charged being able to pick up naphthalene deposited in the form of loose crystals. The gas can be charged with the vapor either by injecting the naphtha into the inlet pipe in the form of a spray, by means of a steam jet, or by filling the the drip at the bottom of the pipe with naphtha which gradually evaporates into the gas passing over it. Naphthalene in the condition named can also be removed by blowing steam into the pipe in sufficient quantity to raise the temperature to the point at which the naphthalene will either melt and run down into the drip, from which it can be pumped out, or vaporize and be taken up by the gas. In all of these methods it is necessary to have gas flowing through the pipes so that the naphthalene as it is vaporized will be picked up by the gas and carried along with it out of the pipe, and there is always danger that the naphthalene so picked up will be again deposited at an inconvenient point during the further travel of the gas. When naphtha vapor is employed this will condense at the same time that the naphthalene is deposited, dissolve the latter and carry it along to the nearest drip, thus preventing any obstruction, but when steam is used the liability is great that the obstruction will be merely transferred from one point of the pipe system to another.

In many cases the presence of naphthalene is not suspected until it has formed on the inside of the portion of the pipe which rises through the water in the tank, a layer of such thickness that it is detached from the sides of the pipe by its own weight and falls into the elbow making the turn from the vertical into the horizontal part running under the tank wall, where it forms a compact mass. Such a mass seems to be very little affected by either naphtha vapor or steam, and must be washed out either with hot water or with naphtha in the liquid form. Hot water may be used in several ways. At one works, the water, heated by means of steam in an old boiler equipped for the purpose, the pressure being run up to between thirty and forty pounds per square inch, was conducted to the holder by a temporary line of pipe. The operation of cleaning out the holder inlet was carried on as follows: The holder was practically emptied of gas, the time chosen being that when the stock of gas was small enough to be contained in the other holders, and kept so as long as possible, though this was merely to keep the weight of pipe to be handled at a minimum, as the holder could be raised through the outlet pipe without interfering with the work. Through a hole drilled in the top of the bonnet over the inlet pipe was inserted a one-inch pipe on the bottom of which was screwed a 1″ x ½″ ell, the direction in which this ell pointed being marked on the pipe at the top. This pipe was made long enough at the start to reach down to the bottom of the holder inlet and a number of short pieces of pipe were provided to screw on as the holder rose. The pipe fitted loosely in the hole in the bonnet, but a practically gas tight joint was made by wet cloths wound round the pipe at this point. The pipe was supported and turned by means of a bar handle clamped on at the proper height. A hose connection being made between this pipe and that from the hot water heater and the water being turned on, it issued from the opening in the ell in a jet which broke up and dissolved the naphthalene and ran down into the drip, from which it was pumped, bringing the naphthalene with it both in solution and in suspension. The drip pump was kept working all the time the water was being run in, so that the water should be pumped out before it cooled down and dropped the naphthalene. The water pipe being turned so that the stream played against all parts of the inlet pipe, a very complete cleaning could be given by this method.

Another method for washing out the naphthalene is called "plunging." In this the inlet pipe is sealed with water, the flange at the top of the vertical pipe outside the holder taken off and the drip pump removed. The pipe is then filled as full of hot water as it is possible to have it without filling up the horizontal run coming to the holder from the station meter. A plunger, or wooden cylinder about eighteen inches to two feet long and a little smaller in diameter than the pipe, fastened to a pipe handle, the axes of the pipe and the cylinder coinciding, is then inserted and worked up and down so as to impart a surging motion to the whole body of water. The surging back and forth of the water dislodges the naphthalene that is not dissolved and the large pieces rising to the surface are fished out, the remaining fine particles being pumped out with the water. It is rather a difficult matter to get the large body of water contained in pipes above 16″ in diameter moving with sufficient velocity to dislodge the compact masses of naphthalene, but if the motion can be produced, "plunging" is a very effective method for the removal of naphthalene from the pipes.

When naphtha or any other liquid solvent is used it is not economical to pour it into the pipe by itself, since, if this is done, it will cut channels in the deposit through which it will run to the drip before it is fully saturated with naphthalene. A better effect can be obtained by pouring water into the inlet until it is filled to half its height. Then from four to five gallons of solvent naphtha are poured in, and the water slowly pumped out at the drip, so that the liquid gradually falls in the main. The consequence is that the solvent, which forms a layer on the top of the water, is forced to act on the whole of the interior surface of the main, both where the latter is upright and where it is nearly horizontal. The time during which it acts on the surface is determined by the the rate of pumping, and thus may be made sufficiently long to complete the solution of the naphthalene. When the solvent has reached the elbow, the rate of pumping is diminished in order to give it time to act on the greater horizontal section of the pipe which then becomes exposed to it. By this method of treatment the whole of the inner surface of the pipe is freed from naphthalene, which is completely removed from the main through the pump. (Trustees.)

4. Describe, with sketches the proper manner in which to make

the feed-water and blow-off connections for steam boilers, and state the faults that are to be guarded against in making such connections.

Ans. The manner of making the feed-water and blow-off connections to boilers necessarily varies with the type of boiler employed. Since horizontal return tubular boilers are used more extensively in gas works than any other type, this answer will be confined to the manner in which these connections should be made for boilers of this type.

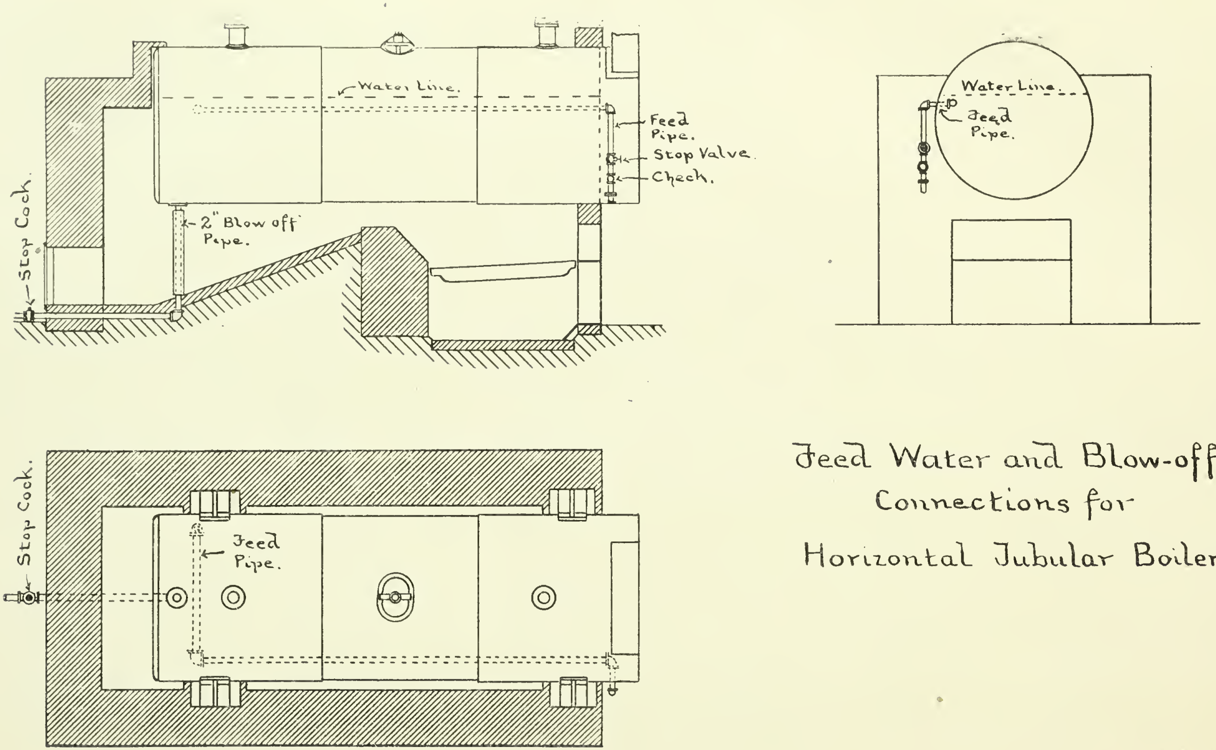
Two important points to be observed in the arrangement of the feed-water pipe in any case are that the comparatively cold feed-water should not be delivered directly against any portion of the shell of the boiler, especially if such portion is exposed to the fire, or to contact with the products of combustion, and that the outlet of the pipe should be so located with reference to the water-line, that as little as possible of the water would be siphoned out of the boiler in case of any accident to the feed-pipe accompanied by failure of the check valve to work.

Even if the feed-water is heated, it is much colder than the shell, and if it is allowed to impinge directly upon the shell, the metal is severely strained by the local cooling to which it is subjected while hot at all other points. It is, therefore, very poor practice to introduce the water directly at the bottom of the boiler, or when it is introduced at a higher point, to have it delivered in a direction that carries it directly against the bottom of the shell. These, however, are very common faults in connection with feed-water pipes. A good feed-water connection is shown on the cut. The pipe is brought up on one side of the boiler at the front (the check and stop valves being placed in the order named at a convenient height on the vertical run) to a point one or two inches below the low-water line, and then run horizontally parallel to the face of the boiler through the front smoke-box to a point about 6″ from the side; then turned and run back through the front and parallel to the side of the boiler to about a foot from the back end; then again turned, still being kept horizontal, and carried at right angles across the boiler to a point about 6″ from the shell on the other side where it ends in an elbow with the open end down. When the pipe is run in this way, the feed-water has an opportunity to become heated by passing through it and is delivered at a point where the water in the boiler is coolest and where there is apt to be a downward current. As the feed-water, even when admitted in this way, is cooler than the water in the boiler, it has a tendency to fall and its admission at the point named helps to secure a better circulation in the boiler.

This arrangement cannot be used with water containing much bi-carbonate of lime, since the deposit formed when water of this description is heated, would soon fill up the long internal pipe. In such cases it is advisable to use a pipe only a few inches long, opening into an open trough or a pipe of larger diameter with the top cut away; this pipe extending the full length of the boiler. Such an arrangement distributes the water well and reduces to a minimum the danger of feed-pipe stoppages.

The feed-pipe to every boiler should be provided with a check valve set close to the boiler in such a position that the valve opens vertically so that its weight assists the pressure of the boiler in closing it. A stop valve should be placed between the check valve and the boiler so that the check valve can be repaired, if necessary, without running the water out of the boiler.

The blow-off pipe is connected to the bottom of the boiler at the back end. It should be made of iron and not of brass or copper, since the latter metals are eaten away by the action of the hot gases to which a portion of the blow-off pipe is necessarily exposed. The part of the pipe so exposed should be covered with some non-conducting material, asbestos rope wound round the pipe being often used. Only straight way valves or stop-cocks should be employed for shut-offs, and the openings in them should be at least the full size of the pipe. A tortuous passage, such as is found in globe valves, affords an opportunity for the trapping of loose pieces of scale against which more pieces collect until the pipe is completely choked up. With a straight way opening of the full size of the pipe, this cannot happen. Gate valves are open to the objection that scale can accumulate in the depression into which the bottom of the valve fits when it is closed and thus prevent the valve from closing tight. In spite of its tendency to stick, a full opening stop-cock forms the best shut-off for a blow-off pipe, but it must be opened full every time the blow-off is used, and care must be taken to shut it slowly to avoid subjecting the pipe to the great increase of pressure produced when the flow of water is stopped abruptly by the sudden shutting of the stop-cock, since this pressure will sooner or later cause a burst



Feed Water and Blow-off Connections for Horizontal Tubular Boilers.

either in the pipe or in the fittings through the strain which it throws upon them. A tee should be inserted in the blow-off pipe just behind the cock so that its tightness when closed can be determined by taking the plug out of the side outlet of the tee and observing whether any water is trickling through the pipe. A tight joint should be made between the end of the blow-off pipe and the drain into which it is led to prevent the hot water splashing back on the boiler attendant. The blow-off pipe should be of good size, at least 2″ in diameter. (Trustees.)

6. What is the maximum amount of gas containing 0.85% by volume of H_2S that can theoretically be purified at one exposure by a bushel of iron sponge, or mass, which contains an amount of $Fe\,O_3.H_2O$ equivalent to a weight of 25 lbs. of iron? It is assumed that no oxygen is present in the gas. (Give the reaction, or reactions, upon which you base your figures, and also give your calculations.)

Ans. The atomic weights of the various elements which enter into combination to form ferric hydrate ($Fe_2O_3.H_2O$) being iron (Fe) 56, oxygen (O) 16 and hydrogen (H) 1, a molecule of $Fe_2O_3.H_2O$ will contain $56 \times 2 + 16 \times 3 + 1 \times 2 + 16 = 178$ parts by weight of which 112 parts are iron and therefore 25 lbs. of iron will form $25 \times \frac{178}{112} = 39.7$ lbs. of ferric hydrate.

According to W. J. Atkinson Butterfield the reactions on which the removal of sulphuretted hydrogen (H_2S) from gas by $Fe_2O_3.H_2O$ chiefly depend are as follows:

$$Fe_2O_3.H_2O + 3\,H_2S = Fe_2S_3 + 4\,H_2O$$

$$Fe_2O_3.H_2O + 3\,H_2S = 2\,FeS + S + 4\,H_2O$$

The proportion between $Fe_2O_3.H_2O$ and H_2S being the same in both these equations, the amount of H_2S absorbed by a given quantity of $Fe_2O_3.H_2O$ will be the same no matter what combination of the two reactions actually occurs.

The atomic weight of sulphur (S) is 32, so the weight of sulphuretted hydrogen (H_2S) entering into the reaction is $3\,(2 \times 1 + 32) = 3 \times 34 = 102$. Therefore 178 parts by weight of $Fe_2O_3.H_2O$ will combine with 102 parts of H_2S or 1 pound will combine with $\frac{102}{178} = 0.573$ pounds, and 39.7 pounds of $Fe_2O_3.H_2O$ will combine with $39.7 \times 0.573 = 22.748$ pounds of H_2S. But one pound of dry H_2S at 60° F. and 30″ barometer occupies a volume of 11.1229 cubic feet so 22.748 pounds will correspond to $22.748 \times 11.1229 =$ 253.02 cubic feet of H_2S.

As the gas is assumed to contain 0.85% by volume of H_2S it will contain 8.5 cubic feet of H_2S per 1,000 cubic feet. $\frac{253.02}{8.5} = 29.791$ and therefore 29,791 cubic feet is the maximum amount of gas containing 0.85% of H_2S that can theoretically be purified during one exposure by a bushel of purifying material which contains an amount of $Fe_2O_3.H_2O$, equivalent to a weight of 25 lbs. of iron. Obviously the amount will vary according to the quantity of H_2S in the gas, and also according to the weight of $Fe_2O_3.H_2O$ contained in a bushel of material.

It is also possible by admitting oxygen with the gas, and thus securing a continuous partial revivification, to purify more gas to an exposure than is indicated by the method of calculation given above. Unless oxygen is supplied, however, the duty actually obtained in practice from any material will always be less than the theoretical amount obtained by calculation, as it is impossible, under working conditions, to thoroughly saturate with H_2S all the $Fe_2O_3.H_2O$ in the material. (Trustees.)

7. Calculate the maximum theoretical flame temperature that can be produced when Hydrogen, H, Marsh Gas, CH_4 and Olefiant Gas, C_2H_4 are burnt in air.

Ans. According to the answer to question No. 9 of the first series for 1901 the maximum temperature that can be produced by burning a gas in air can be determined by dividing the calorific value of the gas, per pound, by the sum of the numbers obtained by multiplying the weight of each of the products of combustion from 1 lb. of gas by its proper specific heat, the nitrogen mixed in the air with the oxygen required for combustion being considered as one of the products of the combustion. For gases containing hydrogen the net calorific value must be taken since it is evident that the water produced by the combustion of the hydrogen will pass off as vapor.

Applying this rule to the different gases named in the question, the following results are obtained. The net calorific value of 1 lb. of hydrogen is 53,406 B. T. U., it requires for its combustion 8 lbs. of oxygen, which being derived from air carries with it $8 \times 3.32 = 26.56$ lbs. of nitrogen and the products of combustion are 9 lbs. of aqueous vapor and 26.56 lbs. nitrogen. The specific heat of aqueous vapor is 0.48 and that of nitrogen 0.244. The maximum flame temperature attainable by the combustion of hydrogen in air is therefore equal to $\frac{53406}{9\times 0.48+26.56\times 0.244}=$

$$\frac{53406}{4.32+6.48}=\frac{53406}{10.8}=4945^\circ \text{ F.}$$

The net heating power of 1 lb. of Marsh Gas (CH_4) is 21,463 B. T. U., it requires for its combustion 4 lbs. of oxygen which is mixed with 13.28 lbs. of nitrogen and the products of this combustion are 2.25 lbs. of aqueous vapor, 2.75 lbs. of carbonic acid (CO_2) and 13.28 lbs. of nitrogen. The specific heats of aqueous vapor and nitrogen are as above and that of CO_2 is 0.217. The maximum flame temperature attainable by the combustion of Marsh Gas in air is therefore

$$\frac{21463}{2.25\times 0.48+2.75\times 0.217+13.29\times 0.244}$$

$$=\frac{21463}{1.08+0.597+3.24}=\frac{21463}{4.917}=4365^\circ \text{ F.}$$

The net calorific value of 1 lb. of Olefiant Gas (C_2H_4) is 20,657 B.T.U. It requires for its combustion 3.428 lbs. of oxygen which is mixed with 11.38 lbs. of nitrogen and the products of this combustion are 1.285 lbs. of aqueous vapor, 3.142 lbs. of carbonic acid and 11.38 lbs. of nitrogen. The specific heats are as above. The maximum flame temperature attainable by the combustion of Olefiant Gas in air is therefore.

$$\frac{20657}{1.285\times 0.48+3.142\times 0.217+11.38\times 0.244}=$$

$$\frac{20657}{0.617+0.682+2.777}=\frac{20657}{4.076}=5068^\circ \text{ F.}$$

(Trustees.)

8. What effect does the saturation of a gas with one vapor have upon the amount of other vapors that can be carried by the gas?

Ans. The effect produced by the saturation of a gas with one vapor upon its power of carrying other vapors depends upon the tension of the vapors in question, and upon the mutual solubility of the liquids from which the vapors are derived. Regnault's experiments prove that " when two liquids exert no solvent action on each other, the tension of the vapors which rise from them is nearly equal to the sum of the tensions of the two separate vapors at the same temperature, while with two liquids that partially dissolve each other, the tension of the mixture is much less than the sum of the tensions, being scarcely equal to that of the vapor with the higher tension ; and with liquids that dissolve in all proportions, the tension of the mixture is intermediate between the tensions of the separate vapors." From these laws it is seen that a gas may be saturated with a vapor without any interference with its capacity for carrying the vapors of liquids which are not soluble in each other or in the liquid from which the first vapor is produced, since as these vapors are added to the gas, the tension increases by the amount required to keep them from condensing. If however, the vapors are from liquids which are soluble in each other, saturation of the gas by any one vapor reduces the capacity for vapors with higher tensions, since the increase in tension due to the addition of the new vapor, is not sufficient to make the combined tension as high as would be the tension of the second vapor, if it existed in the gas alone. On the other hand, saturation with a vapor increases the capacity of the gas for vapors of lower tensions as long as the liquids from which the vapors are produced are soluble in each other, since the mean tension of the mixture of the vapors will be higher than that of the vapor of lowest tension, and therefore, more of this vapor can be carried by the gas. Conversely, the addition of a vapor of very high tension to a gas already saturated with a mixture of vapors of low tension, all the vapors being those of liquids mutually soluble in each other, will slightly increase the capacity of the gas for carrying the low tension vapors, while the addition of a vapor of low tension to a gas saturated with vapors of higher tensions, will decrease the carrying capacity for these higher tension vapors. (Trustees.)

10. The amount of gas unaccounted-for during distribution is expressed sometimes as a percentage of the quantity made and sometimes in terms of the number of thousand cubic feet unaccounted-for per mile of main per year. Which method of expression furnishes the best indication of the condition of the distributing system and the best basis for comparison between different companies and different periods in the history of the same company?

Ans. The method of expressing the amount of gas unaccounted-for in terms of the number of thousand cubic feet unaccounted-for per mile of main per year furnishes a better indication of the condition of the distributing system and a better basis for comparison between different companies and between different periods in the history of the same company than does the expression of this amount as a percentage of the total amount of gas made. The amount of gas sold per mile of main varies so much with different companies that the relation borne by the amount of gas unaccounted-for to the total amount made, may be smaller in the case of a company with a compact district than it is in the case of a company with a sparsely settled territory, even though the distribution system of the latter company is in better condition, as shown by the loss of gas per mile of main, than that of the former. Take for instance, two companies each selling 50,000,000 cubic feet of gas per year, and showing unaccounted-for gas amounting to 5,000,000 cubic feet; one of which has twenty miles of mains and the other sixty miles, the number of meters in use being approximately the same for the two companies. On a percentage basis the two would show the same figures, 10%, for unaccounted-for gas. but, as a matter of fact, the company that shows a loss of 5,000,000 cubic feet on twenty miles of main, or 250,000 cubic feet per mile of main per year, is not doing as well as the one that only shows a loss of 5,000,000 cubic feet, on sixty miles of main, or 83,333 cubic feet per mile per year. The unaccounted-for gas is not made up entirely of gas lost by actual leakage from the mains, being partly due to differences in temperature between the station meter and the consumers' meters and also to inaccuracies of registration on the part of the consumers' meters, but the amount due to these causes would be practically the same in each case, provided the same attention was paid to the testing and repair of the consumers' meters and the maintenance of a proper temperature at the station meter, and the amounts lost by actual leakage would bear to each other very nearly the same proportion as the total amount of the unaccounted-for gas. Therefore, in the instance assumed, the distributing system of the company with 60 miles of mains is really in much better condition than that of the company with 20 miles, although the percentages of gas unaccounted-for are the same. To make the comparison perfectly accurate, the lengths of the different sizes of mains should be reduced to the equivalent length of say 3″ main before the division is made.

For comparisons between different periods in the history of the same company, the percentage system is only correct as long as the sales of gas per mile of main remain about the same. When the sales change decidedly, a decrease in the percentage may coincide with an increase in the amount of actual loss. If, for instance, the company with 60 miles of main increased its sales to 100,000,000 cubic feet per year while its main mileage was increased to 65 miles, a loss of 8% would amount to 8,000,000 cubic feet per year equal to 118,000 cubic feet per mile of main as against a loss of only 83,000 cubic feet when the percentage was 10.

There are of course, cases where conditions are so different that even the loss per mile of main per year does not afford a basis for accurate comparisons, but as a general rule, the conditions which affect the accuracy of such a comparison do not vary as much as do those which affect that of the comparison on the percentage basis. (Trustees.)

11. Describe some method of coating wrought iron pipe, such as is used for services, or some other way by which this pipe can be protected from corrosion.

Ans. The method of coating service pipes that seems to have given the best results, is that which was first employed in Cincinnati after a series of tests made with a number of different coatings. The specifications for this coating are given, and the manner in which it should be applied to the pipes to give the best results is described, in a "Short Topic" prepared by Mr. A. C. Humphreys for the 1895 meeting of the American Gas Light Association, and published in Vol. 13 of the Proceedings, page 186.

The specifications are as follows, "Bring a kettle of tar (20 gallons) to a low boiling point and add 20 pounds of fresh slaked lime, sifted over the top and worked down. Boil down to a paste or a consistency about midway between tar and pitch. Let it settle for a few minutes, then add 4 pounds of tallow and 1 pound of powdered rosin; stir until they are thoroughly dissolved and incorporated with the tar, then let it cool and settle. Ladle off into barrels. When ready for use, to each barrel of 45 gallons of the above mixture add 4 pounds of crude rubber, dissolved in turpentine to the consistency of thick cream. Heat the mixture to about

100% Fahrenheit and immerse the service pipe, heated to about the same temperature."

Different methods have been adopted for applying this mixture, the pipes being dipped in some cases and painted in others. Mr. Humphreys said that the best method was to dip the lengths of pipe into the preparation. In this method the mixture is put into a V shaped trough which is long enough to take the longest length of pipe that is apt to be handled. Along the bottom of this trough is run a steam pipe to heat the mixture to the proper temperature. The pieces of pipe to be coated must also be heated, which can be done either by connecting the pieces to a steam pipe and turning steam on them to give them a test of soundness while they are being heated, or by putting them in a long square box with a hinged cover, the interior of the box being kept hot by means of a steam coil run along the bottom. When the pipes are heated to the proper temperature, they are plugged at both ends to prevent any of the coating from getting on the inside, and are dropped into the hot mixture in the trough. After a few minutes they are taken out, placed on a rack over the trough until the excess of the mixture has dropped off, and then transferred to a drying rack in which they are left until the coating has become thoroughly dry and hard. Care must be taken to keep the pieces from touching each other before they are dry, since, if this is not done, they will stick together and when pulled apart, the coating will stick to one pipe and a bare place will be left on the other. Care must also be taken not to get either the mixture or the pipe too hot, since overheating will drive off the more volatile portions of the preparation, and when the coating cools, it will be brittle and liable to chip off. If the proper precautions are taken and fresh portions of the mixture added from time to time to that already in the trough, the coating will be elastic and will cling very tightly to the pipe. The service gang should, however, be supplied with a pot of the preparation so that after the service is laid the spots where the coating has been scraped off by the tools can be re-coated before filling in the ditch. In some cases the pipe, as it lies in the ditch, is covered for its whole length with an extra layer of the coating, which forms a roof over it.

It will be found rather difficult to dissolve the rubber, but this part of the specifications must not be slighted. Given proper care in the preparation and application of this coating, the pipe covered with it will last much longer than uncoated pipe, and the cost of coating will be more than repaid by the extra life of the services and the lower leakage account. (Trustees.)

12. What is the so-called "Otto cycle" in gas engines?

Ans. The so-called "Otto cycle" in gas engines is a four phase cycle carried out in a single acting cylinder open at the end toward the crank, and provided with a tightly fitting piston which is free to move back and forth.

Starting with the piston at the beginning of an out-stroke the cycle is as follows: As the piston moves out on the forward stroke, the charge of gas and air is drawn in and fills the cylinder. The in or back stroke compresses the charge into the clearance space. At the dead point at the end of this second stroke, the charge is ignited and the resulting explosion drives the piston out on its second forward stroke. The succeeding in-stroke expels the products of combustion from the cylinder and the cycle is completed, the piston being in its first position and ready to repeat the same series of operations. It will be seen that the cycle requires four strokes of the piston for its completion, and that of these four, the third is the only motor stroke, the power required to carry on the others being derived from the energy stored in the fly-wheel during the third stroke. It will also be seen that there is only one explosion for each two revolutions of the fly-wheel.

This cycle was first described and advocated in 1862, by M. Beau de Rochas, and is properly called the Beau de Rochas cycle, but it was not put into practical use until 1876 when it was adopted in the Otto Silent Engine, the first gas engine that was commercially successful and one which held the field almost to the exclusion of all others until the patent expired. (Trustees.)

ANSWERS TO SECOND SERIES OF QUESTIONS, 1901—THIRD SECTION—PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

1. Name and describe the three grades of oil which are commonly used as the carburetting material in the manufacture of carburetted water gas.

Ans. The three grades of oil which are commonly used for carburetting water gas are crude oil, naphtha and gas oil, the last two being obtained from the first by fractional distillation.

Crude Oil is petroleum just as it comes from the oil wells. It is a mixture of liquid hydrocarbons possessing different chemical compositions, specific gravities and boiling points (together with small quantities of other substances) and can be separated into these different substances by fractional distillation. It is found in nearly every country in the world, but the most important fields are in the United States, Russia and Peru. The specific gravity of the petroleum obtained in Pennsylvania and Ohio varies from .80 to .85 water being 1.00. The color also varies but is generally dark claret by transmitted light and greenish by reflected light.

Naphtha is a general name given to that portion of the products of the fractional distillation of petroleum which comes off after gasoline has been driven off and before the fraction suitable for use as burning or lamp oil begins to come off. It is very volatile at ordinary temperatures and highly inflammable. It is practically colorless though some samples show a decidedly greenish tinge by reflected light. Its specific gravity varies from .68 to .74.

Gas Oil is a general name given to that portion of the products of the fractional distillation of petroleum which comes off after the lamp oils and before the lubricating oils. It is too heavy and of too high a boiling point to use for lamp oil, but not viscous enough to make a good lubricant, and is chiefly valuable for the production of gas. Its color varies from quite light to very dark. Its specific gravity also varies but will average about .84. (Trustees.)

2. Describe the operation of a direct fire furnace used for heating coal gas retorts, paying especial attention to the way in which the fire should be handled to secure the most economical results.

Ans. When a direct fire furnace is employed for heating coal gas retorts the carbon of the fuel is burned to carbonic acid (CO_2) in one operation, which is practically completed in the fuel bed, and the retorts are heated principally by the sensible heat possessed by the products of combustion passing off from the fuel bed. It is therefore necessary to so handle the furnace as to produce the highest possible temperature in the fire itself. In fact the fire should be handled very much the same as a boiler fire. The bed of fuel should not be made too deep, a depth of from 15″ to 18″ giving the best results. Fresh fuel should be added at frequent intervals, about once every hour, in order to maintain this depth constant and keep the fire from burning down too low. The grate bars should be shaken lightly from time to time so as to keep the bottom of the fire bright. The condition of this part of the fire can be determined by observing the reflection shown on the water in the ash pan. About 12 hours after the fire has been clinkered a slice bar should be run along the grate bars and the clinker that has formed there should be thoroughly broken up. Clinkering must be thoroughly done every 24 hours. It is impossible to use secondary grate bars when cleaning a furnace of this kind, and so after pushing as much of the fuel as possible up on the slope of the back wall the rest is dropped into the ash pan by drawing away the grate bars, the clinker is cut away from the side and back walls and removed from the furnace, the grate bars replaced, the fuel on the back wall drawn down and spread over the bars and fresh fuel charged into the furnace. The wear and tear on the furnace walls can be reduced by leaving an inch or so of clinker on them at all times, never attempting to take it off down to the brick.

To secure economy of fuel it is necessary to prevent any air from being drawn into the setting through cracks in the brickwork and openings around the frame of the charging door, and to be careful not to have an excessive draft. A direct fire furnace requires more draft to maintain the heat in the bench than does a generator furnace, but an excessive draft is bad in both cases. The appearance of flame at the top of the chimney flues indicates the existence of too much draft, and when it is noticed the dampers should be pushed in.

All flues should be carefully cleaned out at least once a month in order to prevent any stoppages in them that would interfere with the keeping up of the heat, such stoppages being very frequently the cause of low heats when everything is apparently in good order. (Trustees.)

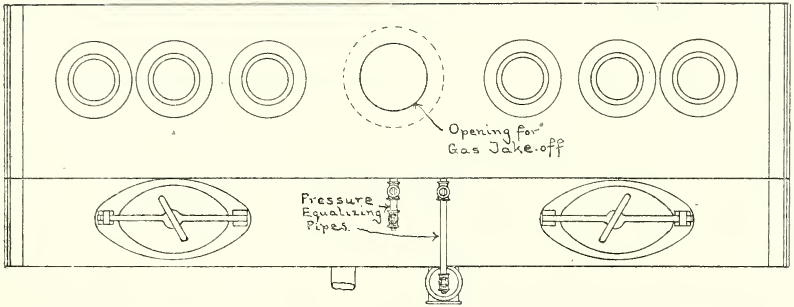
3. Give a description, illustrated with sketches, of one length of hydraulic main for benches of six retorts, including the dip pipes, overflow or overflows, arrangements for cleaning out heavy tar or pitch, and the considerations that determine the area of the surface of liquor in the main outside of the dip pipes.

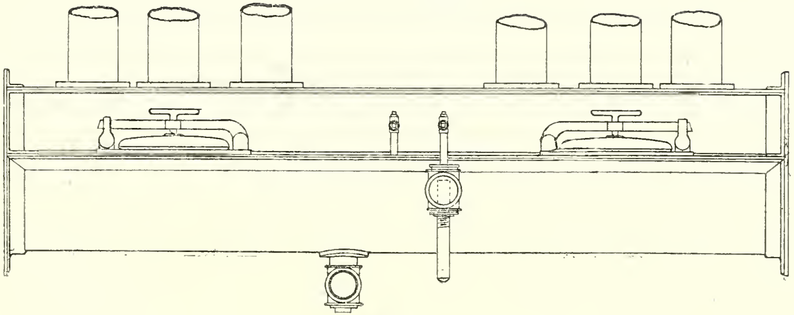
Ans. The hydraulic main for a bench of coal gas retorts should be made of wrought iron. The cross section shown on the accom-

Hydraulic Main.

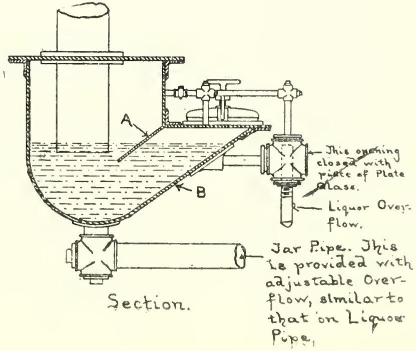
Bench of 6 Retorts.

Plan.





Elevation.


A
B
This opening closed with piece of Plate Glass.
Liquor Over-flow.
Tar Pipe. This is provided with adjustable Over-flow, similar to that on Liquor Pipe.

Section.

panying cut is one of several that are in use. The length of a section would be just a little shorter than the distance between centers of the division walls on each side of the bench, and its width would be such as to give the necessary area of surface of liquor outside the dip pipes, the manner in which this area is determined being explained later.

Circular holes are cut at the proper places in the top plate for the insertion of the dip pipes. These pipes must all be made exactly the same length from bottom of flange to lower end of pipe so that these ends will all be the same distance below the top plate, and will therefore all be sealed to the same depth when the main is set level.

The plate A serves to seal the space between it and the back plate B from the body of the main and thus permits the opening at any time of the cleaning lids, of which there are at least two to each length of main, for the drawing out of heavy tar which is too thick to run off through the tar pipe, without interfering in any way with the process of gas making. The same end may also be attained by making the body of the main U shaped and attaching to it, on the back, cleaning pockets, the openings in the side of the main being made with their top edges below the water line to seal off the pockets from the main so that cleaning can be done at any time without interfering with gas making. The side of the main or of the pocket, as the case may be, along which the tar is to be drawn should be given a gradual slope in order to make it easier to draw out the heavy tar.

The overflows are arranged in various ways. Sometimes a single overflow opening from the bottom of the main is used to draw off both the tar and the ammoniacal liquor deposited in the main; in other instances only the liquor is drawn off by an overflow, the tar being run off at intervals through a drain pipe, while still another arrangement is to have two separate overflows; one for the liquor and the other for the tar. This last is the best arrangement, the objection to the single overflow for both tar and liquor being that it does not maintain a uniform seal on the dip pipes, while running off the tar at intervals entails a certain amount of labor that is avoided by the double overflow, so long as the tar is kept thin enough to run out of itself. Such an arrangement is shown on the cut. In every case the overflows should be made adjustable as to height so that the seal can be varied to suit different requirements, This adjustability is usually obtained by the use of nipples with long threads which can be screwed up or down inside of a suitable fitting. For the liquor overflow an 1½-inch pipe screwing into a bushing set in one outlet of a 3-inch cross may be used. Special weir valves are also made for this purpose. When the overflow opens out of the main below the water level, as is often the case, a connection must be made between the gas space in the main and the space above the liquid in the portion of the overflow outside of the main, so that the pressure on the surface of the liquid in the main and that on the liquid in the overflow shall always be the same. Otherwise the main might be partially emptied of its liquid contents if a heavy pressure was thrown upon it by the stoppage of the exhauster or in any other way.

Each section of the hydraulic main must also be provided with a gas take-off of suitable size which connects it with the foul main.

The area of surface of the liquor outside the dip pipes is determined from the following considerations. It is necessary that the dip pipes should remain sealed when the retorts are open and the surface of the liquor in the dip pipes is subjected to atmospheric pressure, even when the pressure in the main is at the highest point it is likely to attain under the conditions existing in any given works. The unsealing of the dip pipes, when the water is at the proper level, can only be brought about by the forcing up into them of a volume of water equal to the area of the liquor in the main outside of the pipes multiplied by the distance from the normal surface of the liquor to the lower edges of the dip pipes, that is of a volume equal to the surface area of the liquor multiplied by the normal depth of seal. If the depth of seal is taken as 1″, and the greatest pressure that is likely to be thrown on the main as 18″, it will be necessary to have the area in the main outside of the dip pipes, a little more than 18 times as large as the area inside of the pipes, since if it were less than this all the liquor outside the pipes above their lower edges would be forced up into them and they would thus be unsealed, before the height of liquor in them was sufficient to balance the pressure in the main. The rule may be stated in general terms as being that the area outside the dip pipes must always be at least as many times greater than the area inside the pipes as the quotient obtained by dividing the greatest pressure likely to exist in the main by the normal depth of seal that it is the intention to carry. When the main is so designed there is no danger of gas passing back out of the dip pipes as long as the water is kept at the proper height in the main. (Trustees.)

4. Describe one, or more, of the various methods of construction that are employed to reduce to a minimum the damage resulting from an explosion in the blast pipe of a water gas apparatus, and explain how they act.

Ans. One method for reducing to a minimum the damage resulting from an explosion in the blast pipe of a water gas apparatus is to place at different points on the blast pipes relief valves which are loaded so that while they remain tightly closed as long as the pressure in the blast pipe is at or below normal they will be raised as soon as the pressure exceeds the normal. It is usual to place one of these relief valves on each of the elbows nearest to the valves governing the admission of the blast to the various parts of the apparatus. If an explosive mixture of air and gas is formed in the blast pipe during the run and exploded when the blow is put on, these valves are at once opened by the increase in pressure and afford a relief, which if the explosion is not too violent will prevent injury to the blast pipe or blowers.

The same effect may be secured by having one section of blast pipe made very light so that it will give way and relieve the pressure before any damage is done to the stronger portions of the pipe. Duplicates of this light section are kept in stock and can be put in place very quickly so that gas making can be resumed in a short time after the explosion.

A third method is to put at every place at which the blast pipe changes its direction a tee with its free end pointing in the direction that would be followed by the explosive wave travelling back from the apparatus towards the blowers. The end of each tee is flanged and closed by a blind flange of tin bolted on with very light bolts. In case of an explosion these thin flanges are blown off before the pressure rises to a point high enough to damage the pipe especially as they receive the full force of the wave as it travels along.

Another device which prevents the wave from travelling past a definite point in the blast pipe is called an explosion valve. It consists of a box set in and forming part of the blast pipe. This box is divided into two compartments by a partition at right angles to the axis of the blast pipe, and having in it a number of long, narrow horizontal openings, the spaces between the openings being faced on the side away from the blowers. Flaps made from leather or rubber belting backed with iron to give them weight and stiffness, are fastened by their upper edges on the side of the partition towards the apparatus in the spaces between the openings so that each flap hangs in front of and covers an opening.

A pipe at least as large as the blast pipe leads from the top of the compartment nearest the apparatus to a convenient height above the ground, and its open flanged end is covered with a blind flange made of tin and bolted on by small stove bolts. As long as air is being driven through the pipe the flaps are kept off the partition plate and the air passes through freely but when an explosion takes place, beginning, as it always does, at the apparatus, the wave travelling back along the pipe throws the flaps against the partition and closes off any communication with the part of the box on the blower side. At the same time the tin flange is blown off the top of the riser pipe and the pressure relieved. Such a valve furnishes an absolute protection against injury to the blowers. It should be located, if possible, just outside the generator house, but can be put inside of this house if necessary.

Various devices are employed to avoid explosions by preventing gas from accumulating in the blast pipe, but these do not come within the scope of the question. (Trustees.)

5. An illuminating gas has the following composition by volume:

Carbonic Acid	CO_2	2.7%
Oxygen	O	0.7%
Heavy Hydrocarbons	C_nH_{2n}	12.8%
Carbonic Oxide	CO	30.7%
Hydrogen	H	32.4%
Marsh Gas	CH_4	13.9%
Higher Paraffins	C_nH_{2n+2}	2.4%
Benzene Vapor		0.6%
Nitrogen	N	3.8%

Calculate the heating power per cubic foot assuming the heavy hydrocarbons to be Olefiant Gas (C_2H_4) and the higher paraffins to be Ethane (C_2H_6). Calculate both the gross and the net heating power as explained in the answer to question No. 5 of the First Series for 1901.

Ans. The heating power per cubic foot of an illuminating gas can be calculated, when the composition by volume of the gas is known, by multiplying the heating power per cubic foot of each combustible constituent of the gas by the volume of such constituent contained in a cubic foot, as shown by the analysis, and then adding together the products of these multiplications, the sum obtained by this addition being the required heating power per cubic foot of the gas.

The combustible constituents of the gas, the analysis of which is given in the question, are the Heavy Hydrocarbons which are to be considered as being Olefiant Gas (C_2H_4), Carbonic Oxide (CO), Hydrogen (H), Marsh Gas (CH_4), the Higher Paraffins which are to be considered as being Ethane (C_2H_6), and the Benzene Vapor.

The heating power per cubic foot of these various gases are as follows:

		Gross.	Net.
Heavy Hydrocarbons (assumed)	C_2H_4	1,621	1,529
Carbonic Oxide	CO	325	325
Hydrogen	H	328	282
Marsh Gas	CH_4	1,016	908
Higher Paraffins (assumed)	C_2H_6	1,772	1,608
Benzene Vapor	C_6H_6	3,732	3,568

Therefore the gross heating power of the gas is $(1{,}621 \times .128) + (325 \times .307) + (328 \times .324) + (1{,}016 \times .139) + (1{,}772 \times .024) + (3{,}732 \times .006) = 207.5 + 99.8 + 106.3 + 141.2 + 42.5 + 22.4 = 619.7$ heat units, and the net heating power is $(1{,}529 \times .128) + (325 \times .307) + (282 \times .324) + (908 \times .139) + (1{,}608 \times .024) + (3{,}568 \times .006) = 195.7 + 99.8 + 91.4 + 126.2 + 38.6 + 21.4 = 573.1$ heat units.

In round numbers 34% of the net heating power of the gas is derived from the Heavy Hydrocarbons, 17% from the Carbonic Oxide, 16% from the Hydrogen, and 24% from the Marsh Gas contained in it. (Trustees.)

6. Give the formula by which the volume, measured at any pressure and temperature, of a gas saturated with moisture can be corrected to the standard conditions of a temperature of 60° F. and a pressure of 30″ of mercury, and explain the manner in which the formula is derived.

Ans. The formula by which the volume, measured at any pressure and temperature, of a gas saturated with moisture can be corrected to the standard conditions of a temperature of 60° F. and a pressure of 30″ of mercury is $V = \frac{17.64\,(h-a)v}{(460 + t)}$ in which V = the corrected volume at 60° and 30″, v = the volume observed at a temperature of t° and a pressure of h″ of mercury and a = the tension of aqueous vapor at a temperature of t°.

This formula may be expressed in words as follows: The corrected volume of a gas saturated with water vapor at the standard conditions of 60° F. and 30″ barometric pressure is equal to the observed volume multiplied by 17.64 times the difference between the observed barometric pressure and the tension of water vapor at the observed temperature, and divided by the sum of 460 and the observed temperature in Fahr. degrees. The tension of water vapor for the observed temperature must be found from the table giving the tensions for the different temperatures.

The formula is derived in the following manner:

Representing the volume at 60° F. and 30″ pressure by V and that of the same mass of gas at any other temperature t and any other pressure h, by v, we can from the laws governing the change of volume of gases under the influence of changes in temperature and pressure derive the required formula for dry gases. Since the volume varies inversely as the pressure, the product obtained by multiplying the volume at any pressure by that pressure is equal to the product obtained by multiplying the volume of the same mass of gas at any other pressure by the corresponding pressure and we have,

$$30\,V = h\,v \text{ or } V = \frac{h}{30}\,v.$$

Gases expand or contract 1/492 part of their volume at 32° F. for each change in temperature of 1° F., hence the effect of temperature is shown by the equation $V\,(460 + t) = 520\,v$, since t is the number of degrees above 0, and therefore 460 + t is equal to 492, the number of parts at 32° F., plus one volume for each degree increase in temperature above 32° F., while 520 is the number of parts to which 492 parts at 32° will have expanded when the temperature is raised to 60°. From this we obtain the equation, $V = \frac{520v}{460 + t}$. Combining these two equations we have for dry gases $V = \frac{v \times h \times 520}{30\,(460 + t)}$, that is the volume corrected to the standard conditions of 60° F. and a pressure of 30″ of mercury is equal to the observed volume multiplied by the observed pressure in inches of mercury multiplied by 520 and divided by 30 times the sum of 460 and the observed temperature.

The correction for moisture depends on the fact that a gas saturated with water vapor, as will be a gas in contact with and over water, will under the same conditions of temperature and pressure always contain the same quantity of water vapor. This vapor exerts a certain pressure which increases with the temperature, and is proportional to the amount of vapor present The pressure so exerted has been determined in inches of mercury for each degree of temperature. To correct for the presence of moisture in a gas saturated with water vapor it is necessary to deduct the pressure due to the tension of this vapor from the observed barometric pressure, since this barometric pressure is resisted partly by the pressure of the water vapor and partly by that of the gas, and therefore the pressure exerted on the gas will be really only the difference between the barometric pressure and the pressure due to the tension of the water vapor. Calling this tension of water vapor a, and taking its value at the temperature of 60° (.518) to deduct from the standard barometric pressure of 30″ we have for the formula for reducing the volume of gas saturated with water vapor observed at any temperature and pressure to that of gas saturated with water vapor at 60° and 30″,

$$V = \frac{(h-a) \times 520 \times v}{(30 - .518) \times (460 + t)} = \frac{(h-a) \times 520 \times v}{29.482\,(460 + t)}$$

or dividing both enumerator and denominator of the fraction by 29.482

$$V = \frac{17.64\,(h-a)\,v}{460 + t} \quad \text{(Trustees.)}$$

7. What are the different methods employed to determine the quantity of ammonia contained in ammoniacal liquor and consequently the value of the liquor, and which gives the most accurate results?

Ans. The most common and at the same time the least accurate method of determining the quantity of ammonia contained in any given sample of ammoniacal liquor, is to ascertain the specific gravity of the liquor by means of Twaddel's hydrometer and then calculate the content of ammonia on the assumption that each degree Twaddel is equivalent to a strength of two ounces. This method is only appproximately correct at best, and is far from accurate if the liquor contains any uncombined ammonia, since the greater the amount of such ammonia contained in the liquor the lower will be its specific gravity, and consequently the lower its value as indicated by the hydrometer.

A second method which is also more or less inaccurate, according to the composition of the liquor, is to add sulphuric acid to a measured quantity of the liquor until the ammonia is just neutralized, the strength of the acid and the quantity of liquor being so chosen that the results are the same as if pure acid and a gallon of liquor had been taken and the quantity of acid used being accurately measured the amount of ammonia neutralized is calculated from this quantity. The source of error in this method is found in the fact that the "fixed" ammonia salts dissolved in the liquor are not affected by the sulphuric acid, therefore no acid is used in neutralizing the ammonia contained in these salts, and this ammonia is not included in the amount credited to the liquor. In fact, according to Mr. H. L. Greville, in a series of tests made by him, an average of 22.5% of the ammonia present in the liquors was not indicated by this method of testing.

The most accurate method of determining the true value of ammoniacal liquor is that which is known as the Wills or distillation test. In this a measured quantity of the liquor is mixed with a caustic alkali, usually soda, and then exposed to a strong heat for one or two hours. The soda combines with the acids of the ammonia salts in the liquor, setting free all the ammonia contained in the liquor. This ammonia passes off in the gaseous state and is absorbed in a solution of Sulphuric Acid, the amount of acid neutralized being accurately determined. As in the saturation test the quantity of liquor and the strength of the acid used in the test are so chosen that the results can be read off in terms of ounces of ammonia per gallon of liquor. This test gives an exact determination of the amount of ammonia contained in a liquor, and is the one which should be employed in all cases in which it is necessary to determine the value of a liquor as between buyer and seller. (Trustees.)

8. In making meter connections the swivel of the meter union is by some inserted in the end of the lead pipe, the axes of the pipe and swivel coinciding, while by others it is inserted in an

opening made in the side of the pipe with its axis at right-angles to that of the pipe. State, with the reasons for your answer, which method you consider best.

Ans. It is better to insert the swivel in the end of the lead pipe making what may be called a straight connection, rather than to insert it in an opening cut in the side of the pipe making a "shoe connection," as it is sometimes called.

The straight connection is much stronger than the "shoe connection." This follows from their respective methods of construction. The swivel when inserted in the end is fastened to the pipe and held by it along a much greater length than when it is inserted through the side, consequently it is held more firmly and is able to stand a greater strain without breaking the joint and causing a leak.

The swivel being simply a continuation of the pipe the straight connection affords a freer passage for the gas. Unless the "shoe connection" is very carefully made the swivel is apt to be pushed so far into the pipe that it seriously obstructs the passage of the gas even when it is not intentionally pushed far in to secure greater strength. If the hole in the pipe is not cut to the proper size and shape there is also danger of solder running down into the pipe and partially blocking it. The tight fit between the pipe and the swivel in the straight connection prevents any such running down of solder into the pipe. Any obstruction, whether caused by the swivel or by solder, has a tendency to give rise to a deposit of naphthalene in the connection. Even if perfectly made the shoe connection causes the gas to change the direction of its travel very abruptly, and thus throws more pressure than the straight connection, in which the change in direction is never more sudden than that caused by the use of an ell.

The straight connection requires the use of less labor and material in the making than does the shoe connection, since it is not only easier to expand the end of the pipe for the insertion of the swivel than it is to cut a hole out of its side, but in the shoe connection the end of the pipe must also be closed up and soldered together to ensure its tightness.

One claim that is made for the shoe connection is that it is very convenient when meters have to be set close to the ceiling, but even in such cases it is possible to make the connection in other ways that are stronger and more workmanlike, and there is therefore no real reason in favor of this form of connection. (Trustees.)

9 What are the different standard sizes of consumers' meters, and how many burners, each consuming 6 cubic feet per hour, will each size of meter supply?

Ans. The standard sizes of consumers' meters and the number of 6 ft. burners each will supply are as follows:

3	Light	10	Burners	60	Lights	70	Burners
5	“	15	“	80	“	85	“
10	“	20	“	100	“	100	“
20	“	30	“	150	“	150	“
30	“	45	“	200	“	200	“
45	“	60	“	250	“	250	“
		300	Lights.			300	Burners.

It is sometimes assumed that it is safe to connect a greater number of burners to a meter than it is actually capable of supplying because the probabilities are that the burners will never all be lighted at the same time, but it is not wise to take too much risk along this line. (Trustees.)

10. Describe an Argand gas burner and state how it compares in efficiency from a light giving standpoint with flat flame burners.

Ans. The Argand burner is a luminous flame burner in which the gas is burned in an annular flame with separate air supplies for the interior and the exterior surfaces of the flame. The flame is surrounded by a glass chimney. The burner tip is in the form of a hollow cylindrical annulus with a round top which is perforated with a number of small circular holes spaced so closely together that the jets of gas issuing from them coalesce into a solid ring of flame. In the best form of Argands this tip is formed of steatite, or some similar substance, which has the advantages over metal of being a non-conductor of heat and of not being subject to corrosion, and therefore allows the attainment of a higher flame temperature and of a longer life for the burner than is possible with a metal tip. In the centre of the interior air opening is placed a narrow metal spike, like a piece of very thick wire, the object of which is to steady the interior air current and give it a direction of travel parallel to that of the gas. The external air supply is divided into two parts by the use of a frustrum of a hollow cone made of metal which surrounds the tip for its full height. The largest portion of the air supply for the exterior surface of the flame comes into the chimney on the inside of this cone and is directed by it upon the base of the flame, but as the bottom of the cone does not reach quite to the base of the chimney another portion of this air supply enters between the cone and the chimney and ascends next the chimney to supply the upper part of the flame. The gas is supplied to the gas chamber in the tip by three small supply pipes spaced at equal distances around the circle, the combined area of the openings in these pipes being less than that of the opening in the fixture on which the burner is screwed. The number of holes in the tip may be varied, so long as their size is kept such as is suitable to the quality of the gas to be consumed, and their combined area is larger than that of the openings in the pipes through which the gas reaches the tip.

The draft of the chimney used with an Argand burner furnishes a motive force by which the air required for combustion is drawn into the flame and the gas is not required to exert any injector action to accomplish this object, nor is it necessary to have any great velocity of exit from the burner orifice to give the proper shape to the flame. It is therefore possible to have the gas flow from the holes in an Argand burner at practically no pressure, and since the air supply can be very closely regulated by varying the height and size of the chimney used, it is possible to secure very good conditions for luminous combustion in an Argand burner, and consequently these burners give much better illuminating power results from the grades of gas for which they are designed than do the flat flame burners. They are made principally for use with gas with an illuminating value of under 20 candles, and when the gas has a candle power greater than this the Argands in common use are not fitted for its consumption and do not give any better results than, or even as good results as good flat flame burners, although if Argand burners were made especially for such gas there is no reason why the results should not relatively be as good as those obtained with the gas of lower grade. (Trustees.)

11. What are the relative carrying capacities for gas of a 3″ main, a 4″ main, and a 6″ main, the conditions as to length of main, pressure lost by friction, and specific gravity of the gas being the same in each case?

Ans. The formula by which the amount of gas flowing through pipes under different conditions can be calculated is $Q = 1350 \sqrt{\frac{d^5 p}{sl}}$ in which Q is the number of cubic feet of gas delivered per hour, d is the diameter of the pipe in inches, p is the pressure required for overcoming the friction in the pipe, s is the specific gravity of the gas, and l is the length of the pipe in yards. From this formula it will be seen that the amount of gas delivered will, everything else remaining the same, vary as the square root of the fifth power of the diameter of the pipe in inches. The fifth power of 3 is 243, and the square root of this is 15.59, the fifth power of 4 is 1,024, and the square root of this is 32, the fifth power of 6 is 7,776, and the square root of this is 88.18. Therefore the carrying capacities of 3″, 4″ and 6″ pipes are to each other, all other conditions being the same, as 15.58 to 32.00 to 88.18, or as 1 to 2.05 to 5.66. That is a 4″ pipe will carry 2.05 times as much gas as a 3″ and a 6″ will carry 5.66 times as much as a 3″, and 2.76 times as much as a 4″. The same relation holds for pipes of any diameters that bear the relation of 3, 4 and 6 to each other. Thus an 8″ pipe will carry 2.05 times as much as a 6″, and a 12″ 5.66 times as much as a 6″ and 2.76 times as much as an 8″. (Trustees.)

12. What are the characteristics of a good building brick, and how can a brick be tested to determine whether or not it possesses these characteristics?

Ans. Baker's Treatise on Masonry Construction, page 37, contains the following paragraph: "Requisites for Good Brick. 1. A good brick should have plane faces, parallel sides, and sharp edges and angles. 2. It should be of fine, compact uniform texture; should be quite hard, and should give a clear ringing sound when struck a sharp blow. 3. It should not absorb more than one-tenth of its weight of water. 4. Its specific gravity should be two or more. 5. The crushing strength of half brick, when ground flat and pressed between thick metal plates, should be at least 7,000 pounds per square inch."

Regularity of shape can be determined by inspection of the brick, as can also, to a certain extent, compactness and uniformity of texture. The absorptive power, which affects the durability of the brick, especially as regards its resistance to frost, can be determined by weighing the brick after it has been kept exposed in a room under ordinary atmospheric conditions for a week, and then again after it has been immersed in water for from 40 to 48 hours and allowed to dry until all the water on the surface has evaporated, the difference between the second weight and the first one being the weight of water absorbed. The smaller the amount of water so absorbed the greater will be the durability of the brick.

In determining the crushing strength of the brick different methods are followed. Sometimes half brick are tested and sometimes whole ones. In some cases the surfaces to be subjected to the pressure are ground accurately to planes parallel to each other, while in other cases the surfaces are leveled up by putting on a thin coat of plaster of paris, and in still others the bricks are put into a testing machine in the rough state. The best practice is to either grind the faces or level them up by the use of plaster of paris, so that the pressure is applied equally all over the surface. These crushing tests are usually made in a hydraulic press provided with cast iron pressing surfaces which are self adjusting.

The test for transverse strength is about the most valuable that can be given to brick to determine its practical value. It is made by supporting the brick on two supports with thin edges placed the required distance apart and then loading it in the centre with a load which is applied by a beam with a thin edge bearing on the brick, the load required to break the brick being carefully determined. The modulus of rupture as determined by this test should be at least 1,000 pounds per square inch. (Trustees)

ANSWERS TO SECOND SERIES OF QUESTIONS, 1901—FOURTH SECTION—PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

Answers to questions Nos. 10 and 11 have been published in previous volumes of the Proceedings, and can be found there as follows:

No. 10, Vol. XVII, Page 98. (First half of answer to question No. 10 of the Second Series for 1900, Third Section.)
No. 11, Vol. 17 XVII, Page 101.

The answers to the other questions are as follows:

1. Give the meaning of the terms "run of mine," "¾ inch"

and " 1½ inch " as applied to bituminous coal, and state, with your reasons for the statement, which class of coal gives the best carbonizing results.

Ans. " Run of mine " coal is coal which is shipped from the mine in the condition in which it is mined and loaded into the mine cars, being run from these cars directly into the railroad cars, or the boats, as the case may be, without being screened. It consists therefore of a mixture of lumps of all sizes with slack or dust.

" ¾ inch " coal is coal that has been passed over a ¾ inch screen before being loaded into the railroad car, or the boat, and has therefore been freed from the slack and dust as well as from the smaller pieces of coal that pass through the screen.

" 1½ inch " coal is coal that has been passed over a 1½ inch screen and is therefore still more free from small pieces than is ¾ inch coal.

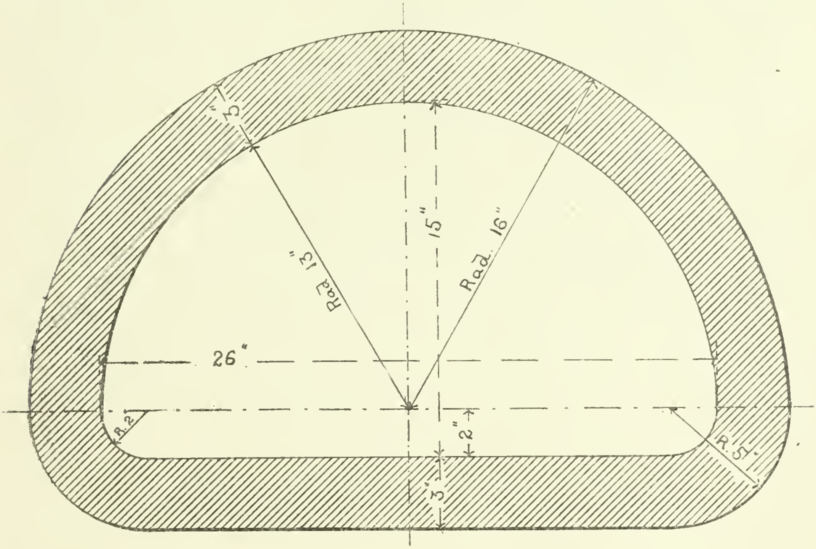
The screens used at the tipples of the coal mines are, as a rule, not made with meshes, but are formed by parallel bars of iron running the long way of the screen. In a ¾ inch screen the bars have a clear space ¾″ wide between them, and in a 1½ inch screen the clear space is 1½″ wide. The openings in the screens are long narrow slits, through which will pass not only the small cubes but also long pieces of small cross-section.

The screened coal gives better carbonizing results than the " run of mine," since the latter is not only harder to burn off, owing to the dust contained in it, which forms in the retort a compact mass through which the heat can only penetrate slowly and with difficulty, but also contains more dirt and slate and a larger percentage of sulphur and will not yield as much gas per pound, or as clean gas, even when carefully and thoroughly carbonized. The majority of companies manufacturing coal gas buy ¾ inch coal, it being thought that as long as the slack is screened out there is no practical difference in value between the small lumps and the larger ones. However, at least one large company uses 1½ inch coal, and the engineer of this company considers that the results obtained from it are enough better than those obtained from ¾ inch coal to more than compensate for the higher price charged for it. (Trustees.)

2. Name the principal shapes of cross-section that have been adopted for clay gas retorts and give a sketch of the cross-section

which you think the best. Show on the sketch the principal dimensions of the cross-section and the thickness of the retort walls. Give the reasons for your choice.

Ans. According to King's Treatise, clay gas retorts have been made with the following cross-sections: Square, square with rounded corners, round, oval, and ⌓ shaped. The last three shapes have been the most used, and in recent years round retorts have almost entirely disappeared, leaving only the oval and ⌓ shapes in general use.



Cross Section of Clay Retort.

There is little to choose between these two shapes. In both the coal can be placed in the retort in a comparatively thin layer of uniform depth over its entire width, permitting of uniform carbonization. The oval retort is a little stronger sideways than the ⌓, but in a well built setting there should not be any great side-strain on the retorts, and as the ⌓ retort can be made with a semicircular top, it is better able to resist the vertical strains to which retorts are most liable to be subjected than is the oval, with its flatter top. It is easier to draw the coke from an oval retort than it is from a ⌓ shaped one with sharp corners, but this difference disappears when the ⌓ is made with rounded corners, and this shape, in the form shown on the accompanying cut, is probably employed in this country to a greater extent than the oval.

The walls of the retort are usually made 3 inches thick with an increase to 4 inches or 4½ inches for about 9 inches to 12 inches at the front end, for the purpose of giving the strength needed for carrying the weight of the mouthpiece. In one large coal gas works in this country the retorts are made with walls only 2½ inches thick.

The dimensions of the cross-section should be governed by the amount of coal that is to be charged, and this depends on the heat that can be secured in the setting. It is bad practice to use in a setting that will not carbonize over 250 lbs. of coal per charge the same size retort that is used in a setting that will burn off 350 lbs. of coal per charge lasting an equal length of time In recuperative benches in which heavy charges can be used the cross-section is usually taken as either 15″ x 26″ or 16″ x 26″. (Trustees.)

3. Describe, somewhat in detail, the starting of a fire in, and the heating up to a working heat of a carburetted water-gas apparatus of the generator-superheater type; and the putting on, making and taking off of the first run.

Ans. It is assumed that the apparatus has previously been in use and therefore does not require to be dried out, and also that during the time it has been out of use all necessary repairs have been made, so that all of the valves and piping are in good condition. Just before making the fire the pressure gauges and seals should be filled with water, and water should be started running through the water cooled valve, if the apparatus is fitted for the reversal of steam. If the condenser is already full of water, no water need be turned on it, nor need any be turned on the scrubber until the set has been heated up and is ready to make gas. The superheater stack valve should be open, and the upper valve of the steam reversal attachment should also be open.

A layer of coarse ashes or clinkers from 6″ to 12″ deep should be spread over the grate bars to protect them from the over heating and warping that would take place during the long blow if the fire were built directly upon them. (If this is properly and carefully done there will be no danger of the bars becoming overheated, but in any case the bottom door of the generator should be opened after the blast has been on for say fifteen to twenty minutes, and if the fire is found to be too hot on the bars a little steam should be turned on with the blast to cool the lower part of the fire, and so protect the bars from injury.) The stoppers should be placed in the stoke holes and the stoke hole doors closed, the ashpit doors being left open. If the water-gas apparatus is used in combination with a coal gas plant the fire can be started by putting into the generator, on top of the layer of clinkers, several barrows of hot coke, followed by a quantity of cold coke, or coal, sufficient to fill the generator half full. If no hot coke is available the fire must be started with wood, enough being used to ensure the ignition of the coal or coke, which may either be put on before the wood is lighted or else put on after the wood fire has gotten well under way. If the first method is employed the coal is put on the wood to a depth of one to two feet, and the wood is ignited from below, the charging lid of the generator being left open until the wood is burning freely, when it is closed, and the products of combustion are drawn through the carburetter and superheater. In this case old oil-soaked waste can be used as a kindling underneath the wood If the coal is put on after the wood has been lighted no kindling is needed, since the fire can be started by throwing a couple of shovelsful of hot coal, taken from the boiler fire, on top of the wood. When the wood is burning briskly the coal can be charged to the proper depth and the charging lid closed.

In either case, when the wood has burnt out, leaving the coal well ignited, the generator lid should be opened, a torch being used as in regular running to avoid an explosion, the generator half filled with coal, the lid closed and screwed down, the ashpit doors closed and sealed up, and the generator blast valve opened, the blower having been previously started. After blasting for a sufficient length of time (say 20 to 30 minutes) to have the coal and upper part of the generator well heated and have the blast gas passing into the carburetter hot, the carburetter blast valve can be opened slightly, using an iron rod with its end heated to a bright red and put through the sight hole to ignite the gas as it meets the air. If the gas is hot enough, it will, when once ignited, continue to burn after the rod is withdrawn, and a blue flame will be visible through the sight hole, but if the gas is too cold the flame will go out when the rod is removed, and the blast must be shut off, to be turned on again later and a second attempt at ignition made.

When the carburetter shows a fair heat, as it will in about thirty minutes after the blast has been turned on to it, the superheater blast can be turned on, the ignition of the gas being effected by a rod heated at the end and inserted through the lower sight hole, the presence or absence of a blue flame after the rod is withdrawn indicating, as in the case of the carburetter, whether the blast can be left on or must be turned off until a higher temperature is reached.

The superheater having been successfully lighted, the blasting is continued until the carburetter and superheater are heated up to nearly the right temperature for gas making, the blast being so adjusted that all the combustible portion of the blast gas is consumed without having any excess of air on the superheater, and the generator being coaled when necessary. The total time required to bring the apparatus to this point after the blast is first turned on will be from 1½ to 2 hours. When it is reached the blast should be shut off, the generator filled with coal and the blasting resumed for from five to ten minutes more, to get the heats to the gas making point.

When this is reached the blast valves are shut, beginning at the superheater and finishing at the generator, the steam is turned on, the stack valve closed, and finally, the oil pump started and the oil admitted to the carburetter. Before turning on the oil for this first run the pressure gauges should be looked at to see if the proper pressure is shown, and so make certain that everything is tight and that there are no large leaks that need to be stopped before gas making can be carried on. During the run the rate at which the oil is being fed into the apparatus must be watched and so regulated that the desired quantity is used. One minute before the end of the run the oil should be shut off in order to avoid loss of oil gas when the run is taken off. At the end of the time allowed for the run the steam is shut off, the stack valve opened, the blast turned on the generator, carburetter and superheater, in the order named, and the apparatus heated up for another run. (Trustees.)

4. The weight of a cubic foot of dry air at 60° F. and 30″ baro-

metric pressure is .076357 lb. The specific gravity of each of the gases named below is set opposite its name. Calculate the weight of a cubic foot of each gas at 60° F. and 30″ pressure.

Methane	CH_4	0.55408
Ethylene or Olefiant Gas	C_2H_4	0.96964
Ethane	C_2H_6	1.0389
Carbonic Oxide	CO	0.96964
Carbonic Acid	CO_2	1.5237
Oxygen	O	1.10816
Nitrogen	N	0.96964
Hydrogen	H	0.06926

Ans. Since the specific gravity of a gas is the ratio between the weight of any given volume of the gas and that of the same volume of air measured at the same temperature and pressure, or in other words, is the quotient obtained by dividing the weight of a given volume of the gas by the weight of an equal volume of air, the weight of a cubic foot of any gas can be found, the specific gravity of the gas and the weight of a cubic foot of air being known, by multiplying the weight of this volume of air by the specific gravity of the gas.

Thus the weight of a cubic foot of Marsh Gas, CH_4, is found by multiplying 0.076357 (the weight of a cubic foot of air) by 0.55408 (the specific gravity of marsh gas), and is equal to 0.042308 lb. All the weights given below are obtained in a similar manner.

Methane or Marsh Gas	CH_4	0.042308 lb.
Ethylene or Olefiant Gas	C_2H_4	0.074039 "
Ethane	C_2H_6	0.079327 "
Carbonic Oxide	CO	0.074039 "
Carbonic Acid	CO_2	0.11634 "
Oxygen	O	0.084616 "
Nitrogen	N	0.074039 "
Hydrogen	H	0.005288 "

(Trustees.)

5. A stand pipe 100 feet high is filled with a gas which is lighter than air. The pipe is rigidly and hermetically sealed so that there is no communication between the air outside and the gas inside. Will the absolute pressure of the gas be the same at

the top and at the bottom of the pipe? If the pressure is not the same, at which point will it be greater? Give the reasons for your answer.

Ans. The only forces affecting the pressure in a pipe filled with gas and hermetically sealed, are the attraction of gravity and the pressure of the gas itself; that is, the force with which it presses against the sides of the pipe. According to the molecular theory of the composition of matter, this pressure which is exerted against the sides of the containing vessel by a gas is due to the incessant striking against these sides of molecules, each of which is trying to get as far away as possible from the others. In the absence of any disturbing force this pressure is exerted equally in all directions, since all the molecules move with the same velocity and have the same weight, and consequently possess the same energy, and as many travel up as travel down or sideways; and if the gas was imponderable, that is, had absolutely no weight, the pressure would be the same at all points in the height of the pipe. But each molecule has some weight and therefore tends, under the influence of the attraction of gravity, to move downward. This tendency to move downward decreases the velocity of the molecules moving upward, while it increases that of those moving downward, and since the force with which the molecules strike against the sides of the pipe or against each other depends upon the velocity with which they move, the molecules moving upward do not strike as hard, and therefore do not exert as much force or pressure as those moving downward. The difference thus produced between the upward and the downward pressure is in every case equal to the weight of the molecules. As, owing to its weight, each molecule from the top down transmits a greater downward pressure than it receives from the molecules above it, the effect is cumulative, and the total pressure at the bottom of the pipe will be greater than that at the top by an amount equal to the weight of the gas in the pipe, and the pressure per unit of area will be greater at the bottom than it is at the top by an amount equal to the weight of a column of the gas of unit area and of the height of the pipe.

The same reasoning applies to the air in the earth's atmosphere, the pressure of which is greatest at the sea level and diminishes with the height above this level by an amount equal to the weight of a column of air of unit area and a height equal to the elevation of any given point above this level. (Trustees.)

6. What is meant by the atomic or combining weight of a substance? What use is made of this weight?

Ans. The atomic or combining weight of a substance is the ratio between the weight of an atom of the substance and that of an atom of hydrogen, the weight of the hydrogen atom being taken as unity, since it is the lightest of all known atoms. The atomic weights of the various elements do not, therefore, represent any absolute weights, but merely the number of times that the atoms of the respective elements are heavier than the atom of hydrogen.

Atomic weights are useful in calculating the proportionate weights in which various substances enter into combination with each other, or into any chemical reaction. Since all chemical compounds are formed by the combination of atoms or multiples of atoms of the various elements, the weights of the different elements in any compound must always be proportional to their atomic weights, and therefore knowing the atomic or proportionate weights of the atoms of the various elements in any compound, the proportionate weights of each of the elements contained in the compound, and of the compound itself, can be determined as soon as the formula of the compound, that is the number of atoms of each element contained in it, is known. The same thing is true of the molecular weights of compound substances, since such substances always enter into chemical reactions in weights proportional to their molecular weights.

As an instance of the use of atomic weights, the formation of Carbonic Acid (CO_2) may be taken. This gas is formed in the combustion of Carbon (C) by the union of Carbon and Oxygen (O). The equation of the reaction between the two substances is $C+O_2 = CO_2$, that is, one molecule of Carbon, consisting of one atom, unites with one molecule of Oxygen, consisting of two atoms, to form one molecule of Carbonic Acid, consisting of one atom of Carbon and two of Oxygen. The atomic weight of carbon is 12 and that of oxygen 16, so the proportion by weight in which they unite is 12 of carbon to 32 of oxygen. That is, 12 lbs. of carbon unite with 32 lbs. of oxygen to form 44 lbs. of carbonic acid, and, whatever the weight of carbon, the weight of oxygen required for its combustion and the weight of carbonic acid produced can be easily found from the above proportions.

In the same way the proportional weights in which any substances enter into chemical combination are determined from their atomic or molecular weights. (Trustees.)

7. What is the unit used in Great Britain and America for measuring and expressing the illuminating value of gas, and what is the value of this unit?

Ans. The unit used in Great Britain and America for measuring and expressing the illuminating value of gas is the "candle power." The literal meaning of "candle power," as a measure of illuminating value, is the amount of light given by the flame of a candle It is, however, evident that the flames of different candles give different amounts of light, and therefore, to obtain an amount of light that shall be as nearly as possible a definite and unvarying quantity and fit to be used as a unit of measurement, it is necessary that the candles employed should be made and burned in accordance with certain rules. Candles so made and used are called standard candles.

It is also evident that after having obtained a standard candle, before any deductions can be made as to the comparative candle powers of different gases as obtained by separate observations, it is necessary that the rates at which and the burners in which the gas is consumed must be uniform, since the same gas consumed at different rates in one burner, or at the same rate in different burners, will give different amounts of light. Therefore the term "candle power" implies the use of a standard candle burning at a definite rate and of a standard burner and rate of consumption for the gas.

The standard candle is a sperm candle of six to the pound and is burnt at a rate of 120 grains of sperm per hour. For a long time these general requirements were the only ones that had to be met, but wide variations in the amount of light given by different candles, all of which fulfilled the above requirements, led the London Gas Referees to adopt regulations for securing uniformity in standard candles, which prescribe the method and materials to be used in the manufacture of the wicks and the melting point of the spermaceti that are to be employed in making such candles. In the absence of any regulations on the subject in this country, it is well to see that the candles used fulfill as nearly as possible the requirements of the Gas Referees. These requirements are given in full in Butterfield's "Chemistry of Gas Manufacture," pages 249 and 252.

The standard rate of consumption for the gas is 5 cubic feet per hour. The form of burner used as the standard varies with the locality and the nature and quality of the gas to be tested. In England, when the gas to be tested is a coal gas of from 14 to 16 candle power, the burner generally prescribed by law for use as the standard burner is a special form of Argand burner known as Sugg's London Argand, No. 1. For cannel gas of from 20 to 26 candle power a flat flame burner is commonly prescribed as the standard. In this country the No. 7 Bray Slit Union burner has been very generally adopted as the standard burner, especially where the gas to be tested is either a carburetted water gas or a mixture of this gas with coal gas. The London Argand is also used in many instances for coal gas. It is always necessary to note what burner has been employed as a standard in each case before any comparison can be made between the reported candle powers of the gases supplied in different localities.

From what precedes it is seen that when it is said that a gas is of a certain candle power the idea intended to be conveyed is that the gas will, when burned in a standard burner at the rate of 5 cubic feet per hour, produce a flame which gives a light equal to that given by a certain number of standard candles, each consuming 120 grains of sperm per hour. (Trustees.)

8. What considerations determine the depth at which street mains should be laid, there being no question of interference with any other pipe systems?

Ans. The principal considerations that determine the depth at which street mains should be laid are their protection from damage by the traffic passing over them and from the influence of the changes in the temperature of the atmosphere.

In Canada and the greater portion of the United States the depth at which mains are laid is governed by the latter consideration, since the depth required for protection from frost is greater than that required for protection from the traffic carried on along the roadway above the pipes. The customary rule is to keep the top of the mains just below the normal frost line. In the vicinity of New York City this requires the mains to be laid with three feet of cover, while in Canada and the Northern and Northwestern parts of the United States, in which the winters are very severe, the depth may reach six feet.

In the Southern States, where winters are mild, the changes in temperature are of minor importance and the mains need not be laid any deeper than is necessary to protect them from the traffic passing over them. For this purpose a depth of 24 inches is sufficient, except in business streets where the traffic is apt to be heavy, in which case 2 feet 6 inches of cover should be given.

When the temperature and traffic conditions are such as to permit of the mains being laid comparatively near the surface, the character of the pavement, either already existing or which will probably be laid in the future, must be taken into consideration and the mains laid deep enough to obviate any danger of the service pipes being interfered with during the laying or repairing of the pavement.

Other pipe systems and subsoil structures also affect the problem at times, but, as stated in the question, these were to be left out of consideration for the purposes of this answer.

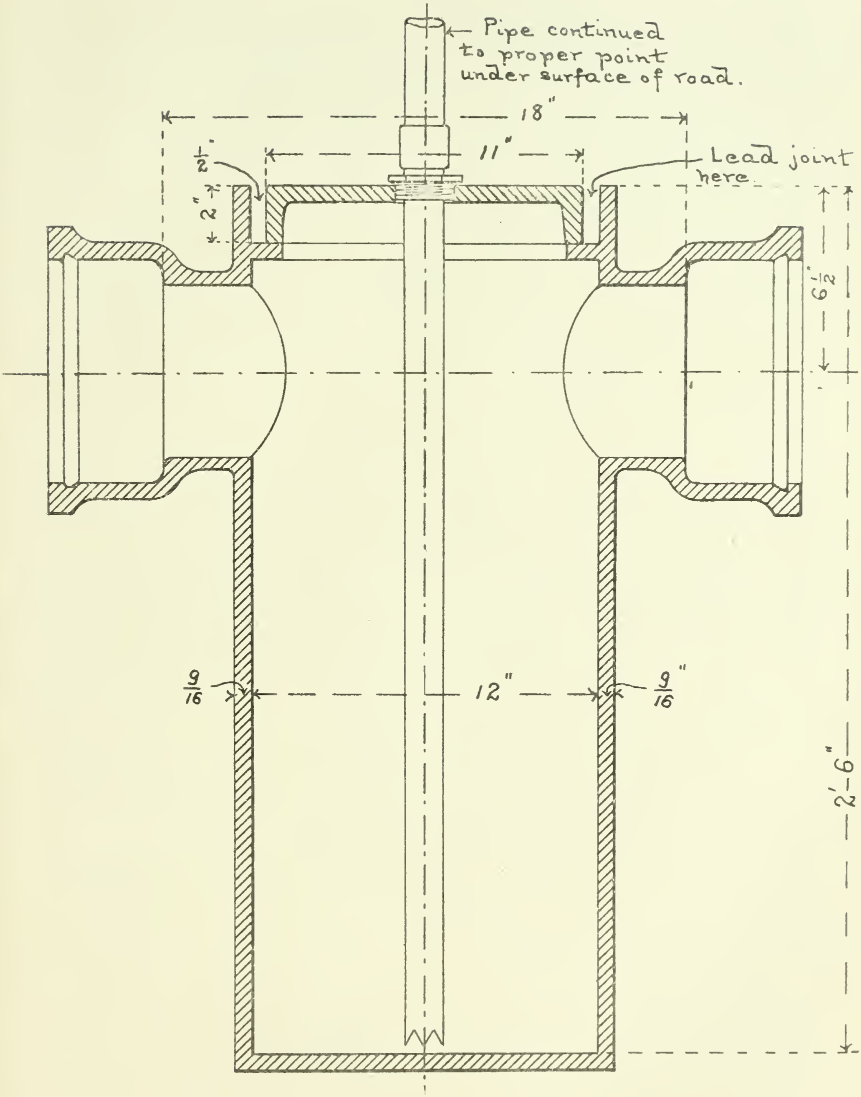
Nothing is gained by going below the depth determined as above, and the deeper the mains the greater is the expense incurred both in their installation and their maintenance. It is therefore advisable not to go any lower than is necessary.

(Trustees.)

9. Describe, with a sketch showing all the dimensions of drip and cover and the arrangement of the pumping pipe, a 6-inch line drip.

Ans. A line drip is a cylindrical vessel made of cast iron. It has a solid bottom and is closed at the top by a removable cover which is usually fastened in place with a lead joint, the lead being run and caulked into a joint space between the cover and the drip. Hubs or bells of the proper size are cast on opposite each other near the top, and by means of these the drip is inserted into the pipe line at the low points and forms part of the line, the gas passing through its upper part while the condensation falls to the bottom.

The condensation is pumped from the drip by a vertical wrought iron pipe, 3/4″ or 1″ in diameter, screwed through an 1 1/4″ x 1″ or an 1 1/4″ x 3/4″ bushing which is screwed into the cover. The lower end of the pipe is serrated and almost touches the bottom of the



6-inch Line Drip.

American Gas Light Association Standard.

Bells made according to standard.

drip, and another piece is screwed on the end projecting above the cover, of such a length that the upper end is just below the level of the roadway, in which is set a drip-box which protects the pipe and at the same time renders it accessible. When the drip is to be pumped, the cap, by which the upper end is closed, is removed and a drip pump screwed on. Sometimes the pumping pipe instead of being carried up vertically to the surface is run under the surface to the curb and then brought to the top.

The cut shows a section of 6-inch drip made according to the standards adopted by the American Gas Light Association.

(Trustees)

12. What is Rosendale or Utica cement, how is it made, and what tests should be applied to any given sample to determine its quality?

Ans. Rosendale or Utica cement, also called natural cement, is made from limestones composed of carbonate of lime, carbonate of magnesia and clay. The limestone is burned in a kiln and then ground to a fine powder. "Any magnesian limestone containing as high as 60% of carbonate of magnesia may be presumed to be capable of yielding hydraulic cement of greater or less value, if properly burned, no matter whether clay be present or not."

Cement should be tested for fineness, liability to cracking and tensile strength.

"Fineness: 90% to 95% of the cement should pass through a sieve of 2,500 meshes per square inch. Other qualities being equal, the finer a cement is ground the greater is its value.

"Checking or Cracking. The test for checking or cracking is an important one, and, though simple, should never be omitted. It is as follows:

"Make two cakes of neat cement, 2″ or 3″ in diameter, about ½″ thick, with thin edges. Note the time in minutes that these cakes, when mixed with the water to the consistency of a stiff, plastic mortar, take to set hard enough to stand the wire test recommended by Gen. Gillmore, $\frac{1}{12}$″ diameter wire loaded with one-fourth of a pound, and $\frac{1}{24}$″ loaded with 1 pound. One of these cakes, when hard enough, should be put in water and examined from day to day to see if it becomes contorted or if cracks show themselves at the edges, such contortions or cracks indicating that the cement is unfit for use at that time. In some cases the tendency to crack, if caused by the presence of too much unslaked lime, will disappear with age. The remaining cake should be kept in the air and its color observed, which, for a good cement, should be uniform throughout (yellowish blotches indicating a poor quality), the natural cements being light or dark according to the character of the rock of which they are made. The color of the cements when left in the air indicates the quality much better than when they are put in water.

"Tensile strength. The tests should be applied to the cement as offered for sale. The following table gives the average minimum tensile strength per square inch which some good cements have attained.

Average Tensile Strength in Pounds per Square Inch.

Age of Mortar When Tested.	Rosendale.	
	Min.	Max.
Clear Cement.		
1 day—1 hour, or until set, in air, the remainder of time in water	40	80
1 week—1 day in air, the remainder of time in water	60	100
4 weeks—1 day in air, the remainder of time in water	100	150
1 year—1 day in air, the remainder of time in water	300	400
One Part Cement and One Part Sand.		
1 week—1 day in air, the remainder of time in water	30	50
4 weeks—1 day in air, the remainder of time in water	50	80
1 year—1 day in air, the remainder of time in water	200	300

"If satisfactory results are obtained with a full dose of sand, the trials need go no further. If not, the coarser particles should be excluded by using a No. 100 sieve, in order to determine approximately the grade the cement would take if ground fine, for fineness is always attainable, while inherent merit may not be.

"Weight. For any particular cement the weight varies with the degree of heat in burning, the degree of fineness in grinding and the density of packing. Other things being the same, the harder-burned varieties are the heavier. The finer a cement is ground the more bulky it becomes and consequently the less it weighs. Hence light weight may be caused by laudable fine grinding or by objectionable under-burning.

"The weight per unit of volume is usually determined by sifting the cement into a measure as lightly as possible, and striking the top level with a straight edge. In careful work the height of fall is specified. The weight per cubic foot is neither exactly constant nor can it be determined precisely, and for the practical purpose of the user is of very little service in determining the value of a cement. However, it is often specified as one of the requirements to be fulfilled.

"The weight of Rosendale cement, determined by sifting the cement with a fall of three feet into a box having a capacity of one tenth of a cubic foot, is 49 to 56 lbs. per cubic foot. The difference in weight for any particular kind is mainly due to a difference in fineness.

"Ulster Co. Rosendale cement weighs 300 lbs. per barrel net; Akron, Milwaukee, Utica and Louisville Rosendales weigh 265 lbs. per barrel net." (Baker Masonry Construction.)

THIRD SERIES OF QUESTIONS, 1901—FOURTH SECTION—PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

1. Name the principal gas coal fields of the United States and Canada, and give the general characteristics of the coal from each field.

2. Describe, with sketches, a retort mouthpiece, showing the manner in which it is fastened to the front of the retort and the arrangement for making a gas-tight joint between the mouthpiece and the lid.

3. Describe the operation of a carburetted water-gas apparatus of the generator-superheater type during its regular working, including in the description an account of how to handle the various blast valves so as to bring the different parts of the apparatus to the proper temperatures simultaneously and without any waste of fuel.

4. Two samples of illuminating gas have the respective compositions given below. Calculate the weight per 1,000 cubic feet and the specific gravity of each sample.

		Sample No. 1.	Sample No. 2.
Carbonic Acid,	CO_2	1.6%	2.7%
Oxygen,	O	0.4	0 7
Ethylene,	C_2H_4	4.3	12.8
Carbonic Oxide,	CO	8.0	30.7
Hydrogen,	H	47.0	32 4
Marsh Gas,	CH_4	36.0	13.9
Ethane,	C_2H_6	0.5	3 0
Nitrogen,	N	2.2	3.8
		100.0	100.0

5. The answer to question No. 5, Second Series for 1901, shows that in a vertical pipe filled with a gas lighter than air the absolute pressure at the lower end of the pipe is greater than that at the upper end. Will the same relation hold if the pressures shown by syphon gauges are taken, instead of the absolute pressures? Give the reasons for your answer.

6. The atomic weights of various elements are as follows:

Hydrogen, H	1	Carbon,	C	12
Oxygen, O	16	Nitrogen,	N	14
Sulphur, S	32	Iron,	Fe	56
Calcium, Ca	40			

Give the molecular weights of and the proportion by weight in which the various elements are contained in the following substances:

Carbonic Oxide	CO
Ammonia	NH_3
Sulphuric Acid	H_2SO_4
Calcic Hydrate or Slaked Lime	$Ca(OH)_2$
Sulphuretted Hydrogen	H_2S
Sulphate of Ammonia	$(NH_4)_2 SO_4$
Ferric Hydrate, or Hydrated Sesquioxide of Iron	$Fe_2O_3.H_2O$

7. Describe, with sketches, some form of Jet Photometer used for determining the candle power of gas, and give your opinion as to the reliability of the results obtained by the use of such an instrument.

8. What do you consider the smallest size of cast-iron pipe which it is advisable to lay for street mains, and what weight per foot or per length of 12 feet do you consider suitable for this size of pipe?

9. Describe, with sketches, a cross, or four-way branch, for four-inch cast iron pipe, giving the dimensions to be used when it is provided with bells, and also those to be used for flanged ends, including the number of bolts and diameter of bolt circle.

10. What details of construction have been adopted in the manufacture of flat flame burners in order to ensure that the combustion of the gas shall take place as far as possible under the conditions stated in the answer to Question No. 10 of the Second Series for 1901?

11. How would you test various samples of gas cooking stoves to determine which was most economical of gas and at the same time did the best cooking?

12. What are the objects sought in mixing sand with lime in making lime mortar and with cement in making cement mortar, and what are the qualities required in a sand to fit it for use in making mortar?

(Answers to these questions are due September 1st, 1901.)

ANSWERS TO THIRD SERIES OF QUESTIONS, 1901—FOURTH SECTION—PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

1. Name the principal gas coal fields of the United States and Canada, and give the general characteristics of the coal from each field.

Ans. The principal gas coal fields of the United States are located in the Appalachian coal field which stretches along the Appalachian mountain range from New York to Alabama, but gas coal is also found in each of the other great coal fields, viz.: the Middle in Illinois, Indiana and western Kentucky, the Western in Missouri, Iowa, Nebraska, Kansas, Arkansas and the Indian Territory and the fields in the far West, the limits of which have not yet been clearly defined nor their resources fully developed.

Among the gas coal districts of the Appalachian field the Pittsburg district which lies immediately east and south of Pittsburg on the Allegheny, Monongahela and Youghioghenny Rivers is prominent. The coal from this district is comparatively hard and dense so that it can be transported without excessive breakage, and yields a good amount of gas of good quality and a clean hard coke. The percentage of sulphur contained in it is small, being usually well under 1%. A fair gas coal is also found in Jefferson and Beaver Counties, Pennsylvania, but this coal is not quite as good as that from the main body of the Pittsburg field.

Another important field is the West Virginia field located in the northern part of West Virginia along the banks of the Monongahela River. The coal in this field is very similar to that obtained from the Pittsburg district, but is less able to stand handling without disintegrating and is apt to contain more sulphur, although some samples show very well in this respect.

The Kanawha district, also in West Virginia, extends back for about 30 miles on each side of that portion of the Kanawha River between Kanawha Falls and Charleston. The coal produced here differs only slightly from the coals mentioned above, except in being apt to contain more sulphur than is found even in the coal mined in the West Virginia district, the percentage running up as high as 1½% in some samples, although as low as 0 6% in others. Cannel coal is also found in paying quantities in this district.

Kentucky possesses a little gas coal but hardly enough to be taken into consideration if it were not for its large deposits of rich cannel coals. The best known of these is the Breckenridge, which besides giving off a large amount of rich volatile matter yields also a fairly good coke which can be mixed to a proportion of 10% with the coke from ordinary gas coal without depreciating the latter.

In Tennessee good gas coal is found in Scott and Anderson Counties, while in Campbell County an excellent cannel coal is mined which is similar to the Breckenridge and is known as Jellico cannel. The gas coal is a clean hard coal fully equal in all respects to that obtained from the Pittsburg district.

In Alabama there are three coal fields, the Cahaba, the Coosa and the Warrior, in each of which some coal is found which can be used as gas coal, but the best coal for this purpose comes from the Corona seam in Walker County. This coal is clean and hard enough to bear handling well.

Although Ohio, Indiana and Illinois produce coal that is used locally for gas making, they cannot be considered as gas coal districts, since the coal is only used for this purpose when the gas works are practically over the mines, and Pennsylvania coal is in demand throughout these States for use in preference to the local coal.

In Kansas the Cherokee field produces gas coal that is good in every respect except that of the amount of sulphur contained in it, and this runs from 2½% to 5% and even as high as 8% in some samples.

The Choctaw country in Indian Territory yields a coal which is clean and hard, stands handling and produces a good coke. It closely resembles the Pennsylvania coals although it contains more sulphur and ash than the latter, the percentage of sulphur being a little over 1%.

The Trinidad field in Colorado also furnishes a clean bright coal that is low in sulphur and is said to give a good yield of good quality gas and from 60% to 70% of compact coke.

On the Pacific coast the South Prairie and Roslyn mines give a coal from which a fair amount of fairly-good quality gas can be obtained and which is low in sulphur but produces a soft, friable and comparatively poor coke.

The principal gas coal fields in Canada lie on Glace Bay and Cow Bay in Cape Breton. These provincial coals were formerly used quite extensively by gas works situated on the Atlantic coast of the United States. They yield a good amount of gas of a quality better than average, but they disintegrate easily, contain a fairly large amount of sulphur and are very susceptible to spontaneous combustion. At the present time their use has been practically abandoned in the gas works of the United States.

Average analyses of some of the coals mentioned above follows:

	Volatile Matter.	Fixed Carbon.	Ash.	Sulphur.
Pittsburg,	35 to 40%	54 to 58%	3 to 5%	0.6%
West Virginia,	35 to 40%	53 to 57%	4 to 7%	1.0%
Kanawha,	34 to 40%	55 to 62%	2 to 4%	0.6 to 1.5%
Breckenridge Cannel,	47%	42%	10%	0.6%
Tennessee Gas Coal,	36 to 39%	56 to 60%	1.8 to 3%	0.8%
Jellico Cannel,	50%	35%	14%	0.7%
Alabama—Corona Seam,	34 to 41%	50 to 59%	7 to 9%	0.7%
Kansas—Cherokee,	37%	52%	9%	2.5 to 8%
Indian Territory,	37 to 40%	51 to 55%	4 to 7%	0.9 to 1.3%
Washington—Roslyn,	28%	61%	9%	0.1%
Colorado—Trinidad,	33 to 37%	51 to 57%	9%	0.7 to 1.4%
Cape Breton	35%	53%	5 5%	3%

(Trustees.)

2. Describe with sketches, a retort mouthpiece, showing the

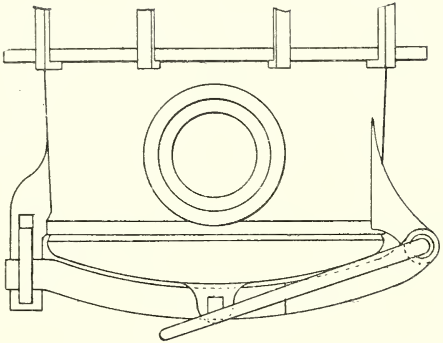
manner in which it is fastened to the front of the retort and the arrangement for making a gas-tight joint between the mouthpiece and the lid.

Ans. Retort mouthpieces are invariably made of cast iron, and such a mouthpiece may be described as being a tube of suitable cross section provided at one end with a flange of the size and shape of the front end of the retort and at the other with a faced lip, the cross section of the mouthpiece at this face being either round or more generally elliptical, no matter what the shape of the retort. The lugs required for supporting the lid and its fastening are cast on the sides of the mouthpiece, projecting beyond its faced edge, and an opening to allow the gas to escape from the mouthpiece is made at the proper place in the sides, at which place is also provided a bell to receive the lower end of the standpipe. The distance from face to face of flange and lip varies from 14″ to 16″, the shape and dimensions of the flange and the opening at the back should be the same as those of the retort and the width and height of the front opening should also be the same as the corresponding dimensions of the retort, although the shape is, as stated, usually elliptical even with D shape retorts.

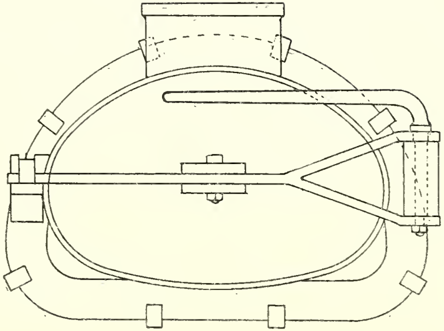
The mouthpiece is generally fastened to the retort by means of ⅞″ bolts about 9″ long, inserted in holes parallel to the axis of the retort made in that portion of the retort wall at the front end which is thickened for the purpose. Each of these holes opens at its inner end into a square recess extending in from the outside of the retort. A square nut is put in this recess and the bolt, which is threaded at each end, is inserted in the hole and screwed into the nut. The spaces left in the holes around the bolts are then filled with iron cement, made of one part by volume of fine iron borings or filings and two parts of fire clay moistened with a solution of sal ammoniac, the front of the retort is plastered with a layer of the same cement and the mouthpiece is put on and drawn up tight by screwing down the nuts put on the bolts. The faces of both retort and mouthpiece should be wet before the joint is made. A great objection to this method of fastening mouthpieces to retorts is that as the bolts burn out after the retorts have been in use for some time, the mouthpieces become loose and it is impossible to keep the joints between them and the retorts tight. It is also impossible to replace a broken mouthpiece by another in case of necessity. To avoid these faults clamps built into the

Mouthpiece with Self-sealing Lid,

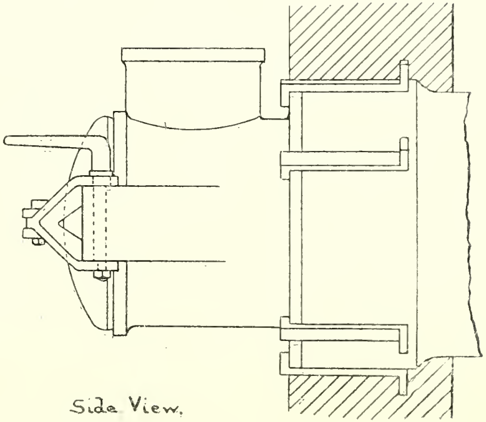
provided with Eccentric Lever Fastening
and clamped to Retort.



Top View.



Front View.



Side View.

front wall of the bench are often used either in conjunction with the bolts or to replace them. Some of these clamps are provided with set screws which screw down on the front of the mouthpiece flange, while others are merely bent over against this front. In any case it is advisable to have the mouthpiece flanges set into the front wall of the bench, the faces of flanges and brickwork being flush with each other. When this is done the brickwork affords a good support to the mouthpieces apart from the fastenings and no injury is done the flanges.

The joint between mouthpiece and lid was formerly made by means of a clay luting, but in recent practice by facing the front of the mouthpiece as described above and making the lid with a V shaped edge, which is also faced, the lids are made self-sealing. The lid is pressed against the face of the mouthpiece either by a cotter bar and screw or by a cotter bar with an eccentric lever handle. The latter form is the one most frequently used. When it is employed the lid is provided with two lugs cast on it with their vertical center lines coinciding with that of the lid and one above and one below the horizontal center line of the lid with sufficient space between them to take the cotter bar to which it (the lid) is fastened by a pin passing through both lugs and the bar. On one side of this fastening the cotter bar branches into two parts with flat circular ends which fit on either side of a lug cast on the mouthpiece. Through this lug and the two parts of the cotter bar passes a pin by which the lid is fastened to the mouthpiece. This pin is turned and the openings in the cotter bar and lug are bored to make the pin a snug fit. The portions of the pin passing through the two parts of the cotter bar are turned to a common center, but that passing through the lug is turned eccentric to the others. A lever handle is welded to the pin and by this handle the pin can be revolved in the lug and cotter bar. The other end of the cotter bar is single and is caught and held, when the lid is shut, by a hook fastened to a lug on the opposite side of the mouthpiece from the hinge lug. This end being held fast, the eccentricity of the different portions of the hinge pin causes the cotter bar to be thrown toward the face of the mouthpiece, when the pin is turned in the proper direction, and thus presses the lid against the mouthpiece with sufficient force to make the joint gas-tight. The center pin which passes through the lugs on the lid and through the cotter bar is also made eccentric and thus furnishes an adjustment by which the pressure produced by the action of the main eccentric can be regulated. (Trustees.)

3. Describe the operation of a carburetted water gas apparatus of the generator-superheater type during its regular working, including in the description an account of how to handle the various blast valves so as to bring the different parts of the apparatus to the proper temperatures simultaneously and without any waste of fuel.

Ans. In the normal operation of a carburetted water gas apparatus the work is usually arranged so that the fire is cleaned early in the working day, and the description of the method of operation will be begun with this cleaning.

After the last run is taken off the apparatus should be blown through with only the generator blast valve open, for say 20 seconds, to free the space below the fire from any water gas, the blast valve should be closed, leaving the stack valve open, the blower shut down, unless two sets are being worked in conjunction, an examination made to see that all steam is turned off from the set and then the ash pit and stoke hole doors should be opened and the plugs removed. Working through the stoke holes with the proper tools (hooks and hoes) all the ashes and soft clinker should be loosened up and removed from around the outside of the fire, leaving the center undisturbed until the work around the sides has been completed. After cleaning out all the clinker that is sufficiently loose and soft to be worked out with the hooks, as much of the hard clinker as possible should be cut away from the walls with chisel bars with a slight bend to enable them to reach the proper points, the lumps cut off being removed from the grate with the hooks. It may be necessary to use a sledge on the bars to loosen the clinker if it is very hard, care being taken not to knock down the fire. When all that can be done around the outside has been done without dropping the fire the ashes and clinker should be cleaned out from the center and the fire dropped on the grate in a solid mass, no large spaces being left unfilled. The center of the fire is left until the last because, as a rule, the clinker here is softest and the fire is apt to drop and interfere with the work as soon as this portion is disturbed, while it will hold up much better on the sides and even if it should happen to come down there before the center is cleaned the soft clinker can be broken up with chisel bars and all the ashes raked out by working between the grate bars with a long hook. The bottom cleaning having been completed and the ashes removed from the ash pit, the ash pit and stoke hole doors should be closed tight, the charging door opened and the fire barred down from the top to cut off from the side of the generator any clinker situated too high up to be reached from the bottom with the bent bars. This barring down is done with long chisel bars of different sizes, varying from light ones which can be handled by one man, for use when the clinker is soft, to heavy ones for hard clinker which require three or four men to work them. If the clinker is very hard it may be necessary to drive the bars with sledges until the holes so made have weakened the clinker sufficiently to allow of its being broken down by the hand bars. In all work with bars care must be taken to keep the bars away from the brickwork, two or three inches of clinker being left on the face of the bricks as a protection against wear and tear. The length of time required for cleaning will vary according to the condition of the fire but will not usually be more than an hour.

The cleaning having been finished the generator should be filled with fuel and the full blast turned on. It will probably be necessary to make several blows and runs before the fire becomes heated through and during these blows the generator blast valve must be kept full open. But when the fire is in good shape the valves on the different parts of the apparatus should be so adjusted as to bring all to the proper temperature simultaneously and without any waste of fuel. The adjustment required for the accomplishment of this object will vary with the condition of the fire and the character of the generator fuel and carburetting material used, and the conditions must be studied for each case. The goal to be worked for is the bringing of the generator up to heat without making any more producer gas than is required to raise the checker work in the carburetter and superheater to the proper temperature for the gasification of the oil. The smaller the amount of combustible gas formed in the generator during the blow the smaller will be the amount of fuel used per 1,000 cu. ft. of gas made and, therefore, no greater quantity of such gas should be produced than is needed for the heating of the carburetter and superheater. In one case it may be found that the most economical fuel results are obtained when the generator blast valve is not fully opened, in others it may be necessary to have it opened wide. Experiments must be tried with each set of apparatus to determine just how the valves shall be handled so as to avoid, as far as possible, the escape of unconsumed CO, as shown by the presence of a blue flame at the superheater stack, and have all parts of the apparatus heated up within the usual time allowed for a blow, say 6 to 7 minutes. When the apparatus is properly heated the same adjustment of valves will give the desired result for each blow as long as the amount of carburetting material used per 1,000 cu. ft. and the amount of gas made per run are not varied to any great extent.

As the operation of putting on and taking off a run was described in the answer to question No. 3 of the Second Series, it is not necessary to repeat it here. After every four or five runs fresh fuel should be put in the generator to keep the height of the fire as nearly uniform as possible. (Trustees.)

4. Two samples of illuminating gas have the respective compositions given below. Calculate the weight per 1,000 cubic feet and the specific gravity of each.

		Sample No. 1.	Sample No. 2.
Carbonic Acid,	CO_2	1.6%	2.7%
Oxygen,	O	0.4	0.7
Ethylene,	C_2H_4	4.3	12.8
Carbonic Oxide,	CO	8.0	30.7
Hydrogen,	H	47.0	32.4
Marsh Gas,	CH_4	36.0	13.9
Ethane,	C_2H_6	0.5	3.0
Nitrogen,	N	2.2	3.8
		100.0	100.0

Ans. In 1,000 cubic feet of gas having the composition of Sample No. 1, there will be:

16 cubic feet of CO_2
4 " " O
43 " " C_2H_4
80 " " CO
470 " " H
360 " " CH_4
5 " " C_2H_6
22 " " N

The respective weights per cubic foot being:

CO,	0.11634	lbs.
O,	0.08462	"
C_2H_4,	0.07404	"
CO,	0.07404	"
H,	0.00529	"
CH_4,	0.04231	"
C_2H_6,	0.07933	"
N,	0.07404	"

the weights in 1,000 cubic feet are:

CO_2,	16 x 0.11634	=	1.86	lbs.
O,	4 x 0.08462	=	.34	"
C_2H_4,	43 x 0.07404	=	3.18	"
CO,	80 x 0.07404	=	5.92	"
H,	470 x 0.00529	=	2.49	"
CH_4,	360 x 0.04231	=	15.23	"
C_2H_6,	5 x 0.07933	=	.40	"
N,	22 x 0.07404	=	1.63	"

and the total weight of 1,000 cu. ft. of gas is 31.05 lbs.

The weight of 1,000 cu. ft. of air is 76.357 lbs. and therefore the specific gravity of the gas is $\frac{31.05}{76.357} = 0.406$.

By the same method of calculation it is found that the weight of 1,000 cu. ft. of the gas having the composition of Sample No. 2 is 48.72 lbs. and its specific gravity is 0.638. (Trustees.)

5. The answer to Question No. 5, Second Series for 1901, shows that in a vertical pipe filled with a gas lighter than air the absolute pressure at the lower end of the pipe is greater than that at the upper end. Will the same relation hold if the pressures shown by syphon gauges are taken instead of the absolute pressures? Give the reasons for your answer.

Ans. The gauge pressures at the two ends of a vertical or inclined pipe filled with a gas lighter than air do not bear the same relation to each other as do the absolute pressures, the gauge pressure at the top being higher than that at the bottom instead of lower. This difference in gauge pressure between the top and the bottom of an inclined pipe is due to the facts that the syphon gauge does not show the actual pressures, but only the difference between the actual pressures exerted on each leg of the gauge, and that the actual pressure of both the outside air and of gas at rest in a pipe decreases in proportion to their weight as the distance of the point of observation from the centre of the earth increases. The actual pressure of both air and gas at the top of the pipe will be less than at the bottom by an amount equal to the weight of a column of air or gas of unit area and of a height equal to the difference in elevation between the two ends of the pipe. As the gas is lighter than air, the weight of the column of gas will be less than that of the column of air Therefore, the actual pressure of the gas will decrease less than the actual pressure of the air, and consequently the difference between the actual pressure of the gas and that of the air will increase with an increase in elevation. The lighter the gas, that is the lower its specific gravity, the smaller will be the decrease in its absolute pressure and the greater the increase in the gauge pressure for any given increase in elevation.

The amount of this increase can be obtained for any particular case by dividing the difference between the weight of a column of air with an area of one square inch and a height equal to the difference in elevation between the two ends of the pipe and that of a column of gas of the same area and height by the weight of a cubic inch of water. For a gas with a specific gravity of .700 and for a difference of elevation of 100′ between the two ends of the pipe, the calculation would be as follows:

The height of the columns of air and gas will be 100′ or 1,200″, and as the area of the columns is one square inch the volume will be 1,200 cubic inches. A cubic foot of air weighs 0.076357 lbs., and a cubic inch weighs $\frac{.076357}{1728} = .00004418$. 1,200 cubic inches of air then, weigh $.00004418 \times 1{,}200 = .053016$ lbs. Since the specific gravity of the gas is .700, the column of gas will weigh 7/10 as much as the column of air, and the difference between the weight of the column of air and that of the column of gas will be equal to 3/10 the weight of the column of air, or to $.053016 \times .3 = .0159048$. The weight of a cubic inch of water is .036 lbs. and the increase in pressure will therefore be $\frac{.0159048}{.036} = .44''$. Thus a gas with a specific gravity of .700 will show an increase in pressure of .044″ for each 10′ increase in elevation, or an increase of 1/10″ for each 22.6′ of rise.

In the same way we find that a gas with a specific gravity of .600 will show an increase in pressure of .059″ for each 10′ of rise, or an increase of 1/10″ pressure for each 17′ of rise; gas with a specific gravity of .500 will show an increase of .073″ for each 10′ of rise, or an increase of 1/10″ for each 13.6′ of rise; gas with a specific gravity of .400 will show an increase of .088″ for each 10′ of rise, or 1/10″ for each 11.3′ of rise, and gas with a specific gravity of .300 will show an increase of .103″ for each 10′ of rise, or an increase of 1/10″ for each 9.7′ of rise. (Trustees.)

6. The atomic weights of various elements are as follows:

Hydrogen, H	1	Carbon, C	12
Oxygen, O	16	Nitrogen, N	14
Sulphur, S	32	Iron, Fe	56
Calcium, Ca	40		

Give the molecular weights of and the proportion by weight in which the various elements are contained in the following substances:

Carbonic Oxide	CO
Ammonia	NH_3
Sulphuric Acid	H_2SO_4
Calcic Hydrate or Slaked Lime	$Ca(OH)_2$
Sulphuretted Hydrogen	H_2S
Sulphate of Ammonia	$(NH_4)_2 SO_4$
Ferric Hydrate, or Hydrated Sesquioxide of Iron	$Fe_2O_3.H_2O$

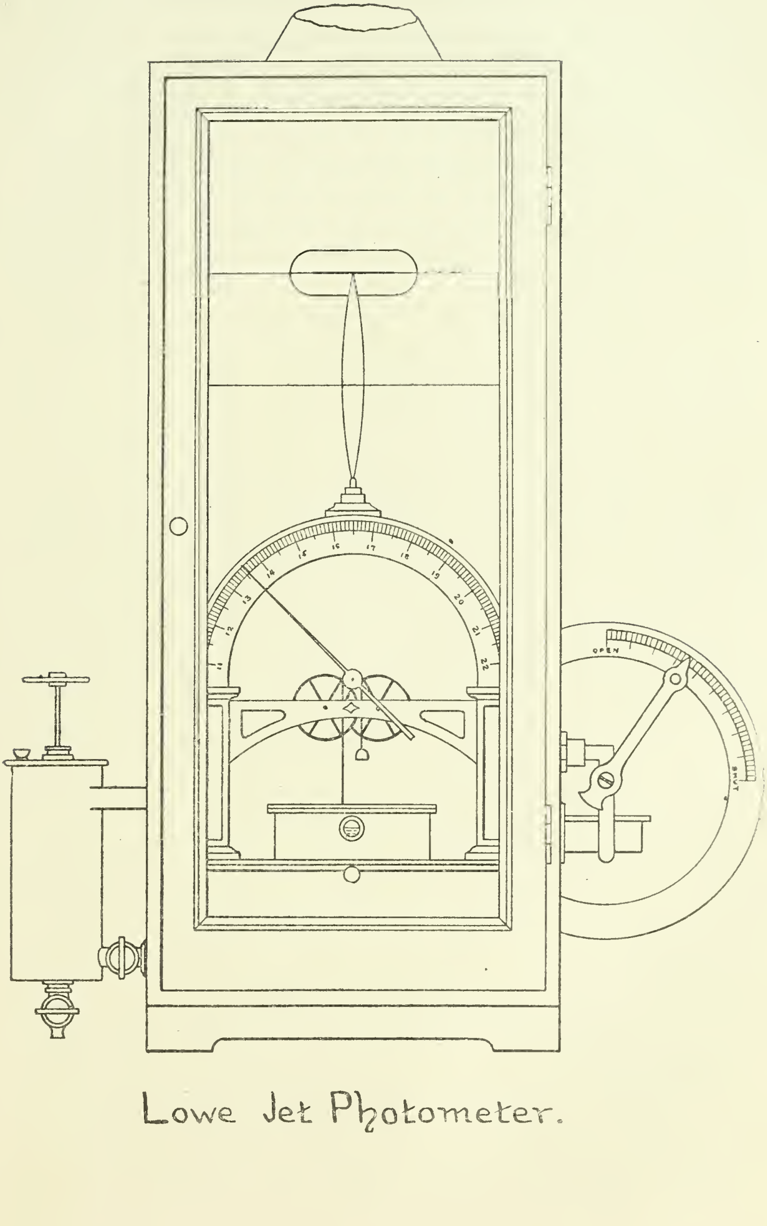
Ans. Each molecule of Carbonic Oxide, CO, contains one atom of Carbon, C, and one of Oxygen, O, and its weight is equal to the sum of the weights of these two atoms. Therefore its molecular weight is equal to the sum of the atomic weights of Carbon, C, and Oxygen, O, or to $16+12=28$. This shows that 16 lbs. of Oxygen, O, unite with 12 lbs. of Carbon, C, to form 28 lbs of Carbonic Oxide, CO, or putting it in another way that Carbonic Oxide, CO, contains $\frac{16}{28}$ or 57.14% by weight of Oxygen, O, and $\frac{12}{28}$ or 42.86% by weight of Carbon, C.

Working in the same way the various substances named are found to possess the following molecular weights and composition by weight :

Substance.	Molecular Weight.	Parts by Weight in which the Elements enter into the Compound.	Percentage Composition by Weight.
$N H_3$	$14 + 3 = 17$	14 of N and 3 of H	82.35% N, 17.65% H
$H_2 S O_4$	$2 + 32 + 64 = 98$	2 of H, 32 of S and 64 of O	2.04% H, 32.65% S, 65.31% O
$Ca (O H)_2$	$40 + 2 (16 + 1) = 74$	40 of Ca, 32 of O and 2 of H	54.06% Ca, 43.24% O, 2.70% H
$H_2 S$	$2 + 32 = 34$	2 of H and 32 of S	5.88% H, 94.12% S
$(N H_4)_2 S O_4$	$2 (14 + 4) + 32 + 64 = 132$	28 of N, 8 of H, 32 of S and 64 of O	21.21% N, 6.06% H, 24.24% S, 48.49% O
$Fe_2 O_3 . H_2 O$	$112 + 48 + 2 + 16 = 178$	112 of Fe, 64 of O, 2 of H	62.92% Fe, 35.96% O, 1.12% H

7. Describe, with sketches, some form of Jet Photometer used for determining the candle power of gas, and give your opinion as to the reliability of the results obtained by the use of such an instrument.

Ans. The Improved Lowe Jet Photometer is an example of the type of these photometers, which determines the candle power of gas from the pressure required to maintain at a fixed height a flame produced by burning the gas through an orifice of a definite size. It consists essentially of a King's pressure gauge on top of which is fixed a small steatite tip, with a fine circular orifice, through which the gas is burned as it issues from the gas space of the gauge. The gauge is mounted in a wooden case with a glass door. On the back of the case a horizontal line is marked at a height of 7″ above the top of the tip and a piece of colored glass on the door has its top edge at the same height. A dry governor is placed in front of the stop cock on the gas pipe leading to the gauge, so that the pressure on the supply side of the stop cock is kept constant. The stop cock has a long lever handle, the free end of which moves over a scale marked on a quadrant attached to the side of the case, as shown on the cut. The gauge is made so as to give the least possible friction, and this in connection with the close adjustment of the supply of gas, made possible by the long handle of the stop cock, enables the height of the flame to be regulated so that its tip is exactly in line with the marks on the door and the



Lowe Jet Photometer.

back of the case as determined by sighting from one line to the other.

In the old form of these photometers the scale on the gauge is graduated to hundredths of an inch and the candle power, corresponding to the pressure which exists when the flame is adjusted to the proper height, is obtained from a table furnished with the instrument, either separately or in the form of an auxiliary scale placed below the pressure scale and properly tied into it. In the more modern forms there is no pressure scale as such, the semicircular scale over which the pointer of the gauge travels, being graduated to give the candle power by direct reading, as shown on the accompanying cut.

It is of course important that the gauge should show the correct pressure, and to do this the water line must be maintained at the proper level at all times. The adjustment of the water line is provided for by a small cylindrical tank mounted on the side of the case opposite to that on which the gas cock is placed. This tank, which communicates with the gauge by a connecting pipe, is provided with a piston, and the space below this piston being filled with water, the water line of the gauge can be readily adjusted to the proper level by moving the piston up or down according as the water is above or below the proper point.

Another style of jet photometer, of which the Jones Jet is an example, determines the candle power of the gas, from the varying height of a flame produced by burning the gas through a small orifice at a constant rate or at a constant pressure. The Jones Jet consists of a steatite tip with a fine circular orifice to which the gas is supplied by a volumetric governor and the candle power scale is marked on a colored glass chimney surrounding the flame.

If illuminating gas could be made at all times of a uniform composition, a jet photometer if once correctly adjusted would give fairly accurate absolute candle-power results. Since it is not possible to make such gas of a perfectly uniform composition such a photometer cannot be depended upon to give absolute results that are accurate, as even when the tip is of the proper size for the kind of gas to be tested and the readings are correct when the gas has a certain composition, any change in this composition will change the readings even though the illuminating value remains the same. It is obviously entirely out of the question to attempt, as is sometimes done, to use the same jet photometer without change of tip for both coal gas and carburetted water gas, or a mixture of coal gas and carburetted water gas.

The true field of the jet photometer is to furnish a rapid method of obtaining frequent tests of candle power that can be compared with one another and thus afford a check upon manufacturing results that can not be obtained by comparatively infrequent tests made upon a bar photometer. But even when used in this way the reading of a jet photometer should be compared every day or two with the candle power as shown by a bar photometer in order to be certain that through change in composition of the gas or in the size of the orifice in the tip, these readings do not vary too much from the actual candle power of the gas. (Trustees.)

8. What do you consider the smallest size of cast-iron pipe which it is advisable to lay for street mains, and what weight per foot or per length of 12 feet do you consider suitable for this size of pipe?

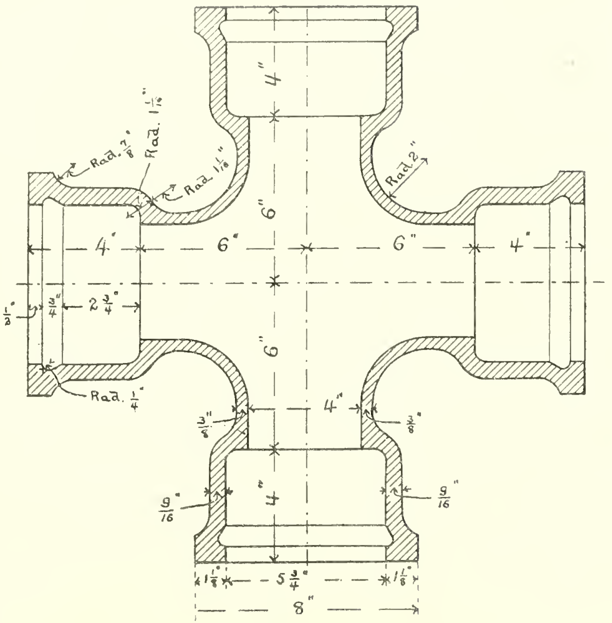
Ans. It is not good practice to lay any cast-iron pipe of a smaller diameter than 4″, except in localities where it is reasonably certain that a smaller pipe will be able to deliver for an indefinite period, without undue loss of pressure, all the gas required in the territory to be supplied.

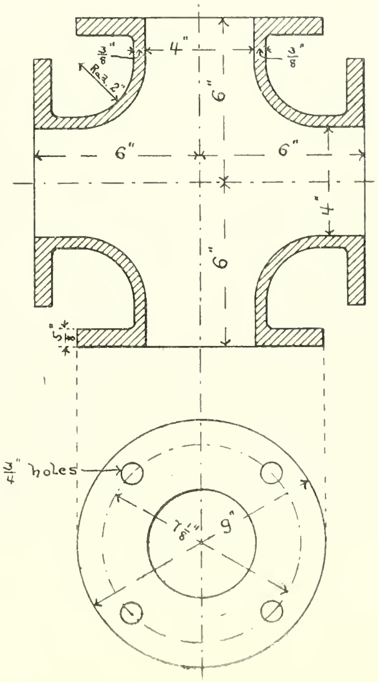
A good average weight for 4″ inch cast-iron pipe is 220 lbs. per length of 12 feet, or about 18 lbs. per foot. For use in very small towns lighter pipe can be employed, while in some locations in large cities heavier pipe is needed, but for general use the above is as stated good average weight. (Trustees.)

9. Describe, with sketches, a cross, or four-way branch, for four-inch cast-iron pipe, giving the dimensions to be used when it is provided with bells, and also those to be used for flanged ends, including the number of bolts and diameter of bolt circle.

Ans. A 4″ cross or four-way branch made according to the American Gas Light Association standard is shown on the accompanying cut. The bell cross has a bell on each outlet unless otherwise specified, although any desired combination of bell and spigot ends can be made. The distance from the center line of each run to the bottom of the bells on the other run is 6″. The depth of the bells is 4″ and the other dimensions are as shown on the cut.

For a flanged cross the distance from the center line of the runs to the faces of the flanges is 6″ in each case. The outside diame-





Four-inch Tees with Bells and Flanges.

American Gas Light Association Standard.

ter of the flanges is 9″, the diameter of the bolt circle is 7⅛″ and the flanges are drilled with four ¾″ holes placed as shown. (Trustees.)

10. What details of construction have been adopted in the manufacture of flat flame burners in order to ensure that the combustion of the gas shall take place as far as possible under the conditions stated in the answer to Question No. 10 of the Second Series for 1901?

Ans. The following details of construction have been adopted to put into effect the principles brought out in the answer to Question No. 10 of the Second Series for 1901. To ensure the existence of a low pressure at the burner tip the improved forms of flat flame burners are provided either with some form of governor, which maintains the pressure at the tip constantly at the proper point, no matter how much the pressure on the piping increases, or else with a "check," which is usually a metal, steatite or lava disk inserted in the burner pillar so as to cut off any flow of gas to the tip except through a hole in the disk, the area of which is smaller than that of the opening in the tip, the relation between the area of the opening in the check and that of the opening in the tip varying with the pressure at which the burner is designed to be used; that is, the higher the pressure the smaller the hole in the check for the same sized tip.

In order to maintain the temperature of the flame at as high a point as possible the burner tip should be made of a non-conducting substance, since if made of metal or any other good conductor of heat the heat which is absorbed and carried away by the tip reduces the temperature of the flame. In all of the best forms of flat flame burners the tips are now made of either lava, steatite or enamel, all of which are poor conductors of heat.

To produce a steady even flow of gas without any swirling motion some burners have placed between the check and the tip a screen of fine wire gauze which breaks up any currents, and renders the flow of gas uniform throughout the whole area of the burner pillar, while others depend upon the steadying action produced by the large area of the burner pillar above the check as compared with the area of the opening in the tip.

To secure an equal supply of gas to all parts of the flame, slit (batswing) burners are made with what is called a hollow top, by means of which the slit is kept of the same depth in all parts instead of being much thicker at the top than at the sides, as it would necessarily be if the top of the tip were left solid instead of hollowed out inside to conform with its shape outside. The effect of extra thickness at any place is that less gas passes through the slit at the thick place, and that consequently the conditions are not the same at all parts of the flame. A further improvement in this direction, introduced in some burners, consists in cutting the slit with a circular saw applied from above the tip and thus making it curved on the bottom instead of flat, as is the case when it is cut by sawing in the ordinary way. With the flat-bottom slit some of the gas issues at right angles to the axis of the burner only to be folded back on the upper part of the flame by the upward draft of air caused by the heat of the flame, while with a curved-bottom slit this effect is avoided as the gas issues in a direction along which it is free to travel without being turned aside, and the flame is thus kept of more even thickness throughout.

In Sugg's table top burners the effect of the upward rush of air in increasing the thickness of the lower edges of the flame is still further guarded against by forming a circular "table" immediately under the top of the tip, the projection of which deflects the currents of air and prevents them from rising vertically against the flame. (Trustees.)

11. How would you test various samples of gas cooking stoves to determine which was most economical of gas and at the same time did the best cooking?

Ans. The comparative efficiency of the top burners of various samples of gas stoves may be tested by determining the length of time and amount of gas required to heat a definite quantity of water from a temperature of say 60° F. to the boiling point. The same kettle should be used throughout the tests and the weight of water employed, its temperature at the start, the exact time at which it begins to boil and the amount of gas consumed must be accurately determined in each case.

The efficiency of the ovens may be tested by determining the time and amount of gas required to bring each oven up to a baking heat and then to bake a definite weight of either bread or biscuit. The dough must be all ready to put into the oven as soon as the required heat is attained so that no gas is wasted while waiting for the dough to be gotten ready, since any delay of this kind would spoil the tests. Each oven should also be tested for evenness of distribution of the heat throughout its whole interior. This can be done by placing pieces of white writing paper in different parts of the oven, and noticing the extent to which the different pieces are browned when the oven is hot enough to bake. The more nearly they all approach to the same color the more uniform is the distribution of heat throughout the oven, and the better will it bake. As a rule the ovens that show a good efficiency by the baking test will also show a uniform distribution of the heat. (Trustees.)

12. What are the objects sought in mixing sand with lime in making lime mortar and with cement in making cement mortar, and what are the qualities required in a sand to fit it for use in making mortar?

Ans. "Sand is mixed with lime or cement to reduce the cost of the mortar; and is added to lime also to prevent the cracking which would occur if lime were used alone. Any material may be used to dilute the mortar, provided it has no effect upon the durability of the cementing material and is not itself liable to decay. Pulverized stone, powdered brick, slag, or coal cinders may be used; but natural sand is by far the most common, although fine crushed stone, or 'stone screenings,' are sometimes employed and are in some respects better than natural sand.

"To be suitable for use in mortar, the sand should be sharp, clean, and coarse; and the grains should be composed of durable minerals, and the size of the grains should be such as to give a minimum of voids, *i. e.*, interstices between the grains.

"The usual specifications are simply: 'The sand shall be sharp, clean and coarse.'

"Sharp sand, *i. e.*, sand with angular grains, is preferred to that with round grains because (1) the angular grains are rougher and therefore the cement will adhere better; and (2) the angular grains offer better resistance to moving one on the other under compression.

"The sharpness of sand can be determined approximately by rubbing a few grains in the hand, or by crushing it near the ear and noting if a grating sound is produced; but an examination through a small lens is better. Sharp sand is often difficult to obtain, and the requirement that 'the sand shall be sharp' is practically a dead letter in most specifications.

"Clean sand is necessary for the strongest mortar, since an envelop of loam or organic matter about the sand grains will prevent the adherence of the cement. The cleanness of sand may be judged by pressing it together in the hand while it is damp; if the sand sticks together when the pressure is removed, it is entirely unfit for mortar purposes. The cleanness may also be tested by rubbing a little of the dry sand in the palm of the hand; if the hand is nearly or quite clean after throwing the sand out, it is probably clean enough for mortar. The cleanness of the sand may be tested quantitatively by agitating a quantity of sand with water in a graduated glass flask; after allowing the mixture to settle, the amount of precipitate and of sand may be read from the graduation. Care should be taken that the precipitate has fully settled, since it will condense considerably after its upper surface is clearly marked.

"Although it is customary to require that only clean sand shall be used in making mortar, a small quantity of very finely powdered clay will not materially decrease the strength of the mortar. In some instances clay to the amount of 10 per cent. of sand seems not to decrease the strength of the mortar. Mortar containing considerable clay is much more dense, plastic, and water tight; and is occasionally convenient for plastering surfaces and stopping leaky joints. Such mortar is not affected by the presence of water.

"Coarse sand is preferable to fine, since (1) the former has less surface to be covered and hence requires less cement; and (2) coarse sand requires less labor to fill the interstices with the cement. The sand should be screened to remove the pebbles, the fineness of the screen depending upon the kind of work in which the mortar is to be used. The coarser the sand the better, even if it may properly be designated fine gravel, provided the diameter of the largest pebble is not too nearly equal to the thickness of the mortar joint.

"If the voids are filled with cement, uniform coarse grains give greater strength than coarse and fine mixed; or, in other words, for rich mortar coarse grains are more important than small voids. But if the voids are not filled, then coarse and fine sand mixed give greater strength than uniform coarse grains; or in other words, for lean mortar a small proportion of voids is more important than coarse grains.

"As a rule, the sand ordinarily employed in making cement mortar is much too fine to give maximum strength, or to permit the use of a minimum amount of cement.

"The smaller the proportion of voids, *i. e.*, the interstices between the grains of the sand, the less the amount of cement required and consequently the more economical the sand.

"Very fine sand makes a much weaker mortar than coarse sand and natural sands vary considerably in the proportion of voids and consequently differ in the amount of cement required to produce any particular strength. Therefore, before adopting a sand for a work of any considerable magnitude, all available sands should be carefully examined with reference to (1) their effects upon the strength of the mortar, (2) their per cent. of voids or the amount of cement required with each, and (3) their cost. If mortar of any particular strength is desired, the proportion of cement should be adjusted according to the fineness and voids of the best available sand." (Baker's Masonry Construction.)

(This appendix to the report of the Trustees Gas Educational Fund was not read at the meeting.)

THE PRESIDENT:—What disposition do you desire to make of this report?

MR. JENKINS:—I move that it be received and spread upon the minutes.

Carried.

THE SECRETARY:—Unless some objection is made, I will follow the usual procedure and append to this report a full set of the questions and answers which have been sent out during the year.

THE PRESIDENT:—There is no objection to that.

On motion of Mr. Walton Forstall the reading of the reports of the other Special Committees was postponed until after the reading of the President's address.

THE PRESIDENT:—I am advised that the Committee on Nominations, the report of which would be next in order, is not quite ready to report, and if there is no objection the reading of that report will be called for later in the session.

Next in order will be the reading of the President's address, and I will ask Vice-President Beal to take the chair.

The President then read the following:

PRESIDENT'S ADDRESS.

Gentlemen of the Association:—Another year has passed into history, and we find ourselves gathered for the Twenty-ninth annual meeting of this Association, in the city of this country, from which,—those of us who are so fortunate as to have lived at some time within its influence, believe it is from here,—all knowledge is supposed to emanate. Therefore, it is eminently fitting and proper that, standing in the doorway of the Twentieth Century, we should convene here with the assurance that this meeting shall be, at least, the equal of any that have gone before; and, viewed from the standpoint of history, patriotism and enthusiasm, a meeting in such a city, and under such circumstances, can be nothing short of success.

At the beginning of our proceedings, I deem it my duty to speak a word in memory of our late President of the United States, William McKinley, whose cruel death we all mourn. It is especially fitting that a halt be made in the proceedings of this organization of business men while we lay tribute upon the grave of a man who seems to us as nearly perfect in his private and public life as mere mortals can be. He had been a patriot from his youth up, serving his country in war in early manhood. He learned to love his country in the years of his country's distress, and the patriotism thus grounded and rooted was such as caused him to be constantly mindful of the republic's welfare. When the war threatened, he was determined not to have war until all efforts toward peace had been tried and found wanting, and then, when war came he pursued it with the vigor which alone characterizes the race of people born to independence, self reliance and courage. The country mourns McKinley; the world mourns McKinley, and this Association representing such great interests will certainly pardon this brief reference to a man whose life had been given for his country and who had been singularly free from the common frailties of men. It is especially proper at this our meeting in Boston, the "cradle of liberty," that we all pay tribute to a man who loved liberty, and died exemplifying the freedom and equality of all American people.

It has been the custom of my predecessors, I believe, to briefly review what has transpired during the year, what successes have been attained, and to declare for the future so far as present indications may suggest.

In retrospect, therefore, what has been accomplished during the year that is worthy of mention here? It is certain that we are working along conservative lines, and that progress is being constantly made; but nothing startling has been developed or accomplished. In manufacture, we believe that money is saved here and there only where attention is given to details; in truth, the difference between good and ordinary results may be gauged by either indifferent or close attention to minute details; and it goes without saying that the Superintendent or Manager of a works must have the education, inclination, and disposition on his own part backed by the assistance, appreciation, and liberality of his superiors, and the interest and co-operation of his subordinates and those in his employ, in order that he may bring about such a happy condition as will enable him to analyze his work from day to day, and to discover here and there where these details, to which I make reference, can be improved upon.

At this time we hear much about drawing and charging machinery, and inclined retorts for the large coal gas works of this and other countries; and I doubt not that for such works this sort of machinery and construction will be adopted where not now in use; but, who will say that for the average sized gas works of this country either would be applicable from the standpoint of economy? I do not wish to be understood as saying that such appliances and construction are not practicable even for small works, but up to the present time, so far as I have information, neither, for obvious reasons, I believe, would be profitable.

There is opportunity for the average sized works to develop or improve its mechanical devices for the more economical handling of coal and purifying material, and where the preparation of coke for the trade, may be reduced to the minimum. I do not mean to convey the idea but that this is being done at many works, possibly at more than I have knowledge of, and yet, with what I have seen, there is chance for improvement along these lines.

During the past three years there has been a decided advance in the price of oil for gas making purposes, which advance, and the fact that coal prices were down in 1899 and 1900 caused many gas managers to either revive their old coal gas benches or to build new ones. These changes, where changes have been made, were, during this period, of practical advantage, especially in localities where the standards of candle power required were not so high as to make the exclusive manufacture of coal gas prohibitive. And yet, during this period of high priced oil and low priced coal, I have it upon good authority that the number of water gas machines and their aggregate capacities have been increased each year during the past three years. This may be due either to the great energy displayed by manufacturers of water gas apparatus, to the comparative cheapness of such apparatus over modern coal gas installations, or to conditions depending upon locality; but presumably because it has become a well defined policy by the gas companies of this country that in cities of 30,000 people and upwards, the interests of their patrons would at all times be better served by having both types of apparatus at their command.

Concerning the price of oil, it is undoubtedly true that the tendency to advance prices has received a check by the recent discoveries of oil in Texas. Whether this oil will be economical for us to use will depend upon price and the results of trial, to be determined by experiment and experience. Elaborate experiments in the use of Texas oil have been made at the works under my management during the past summer, but the conclusions reached, as a result of these experiments, and in comparison with other oils, I am not prepared to state, for enough information is contained therein to furnish material for an instructive paper. Certain it is, that the discovery of oil in Texas has had a stimulating effect in the erection of new water gas apparatus. The estimated daily output of the Beaumont (Texas) oil field is 700,000 bbls., although doubt exists in the minds of those who are in a position to know, as to the correctness of the statement; but, comparing the estimated daily output of other oil fields outside the Beaumont district, (160,000 bbls) and making a liberal allowance for the former estimate, we cannot but conclude that any further advance in present rates for oil is, to say the least, remote. The permanence of the so-called Beaumont "gushers" cannot be predicted, but the discovery of oil there will undoubtedly stimulate a large amount of prospecting all over Texas, with the belief that other paying "strikes" will be made in the near future.

There appears to be no diminution in the quantity of good gas coals in sight, and as the price of this product is regulated almost entirely by rates for transportation, the price at the mines remaining almost constant, it would seem, in view of the circumstances, that railroad companies may, and undoubtedly will, make rates that will enable those of us remote from water transportation to still seriously consider whether it shall be coal gas, water gas, or both.

The item of purification is now such a small one as compared with former years, that while new schemes have been advanced in the number, arrangement, and construction of boxes employed, the notion prevails that with four boxes of ample size, a good quality of oxide, and convenient means for handling it quickly. we would hesitate a long time before adopting anything different.

The market for residual products continues good, and especially that for coke. The demand for the latter is, of course, in a large degree, due to locality and controlled by the price of anthracite and bituminous coal in that locality; but there is very much in educating people to an intelligent and economical use of coke in whatever sort of appliance it is to be used. I wish to emphasize the word education, as used in this sense, for I know from experience that much can be accomplished in this direction, for I presume there is more ignorance displayed by the average individual in the operation of any heating device requiring fuel, and especially in the economical use of coke, than in almost anything else.

Upon the important question of storage, we find that even though ample holder capacity is an excellent precaution, we can run much closer to any demands made upon our works than formerly; and this condition has been brought about principally by the introduction of water gas apparatus. It might also be truthfully said that the successful distribution of gas under high pressure, eliminates in a large degree the necessity of having holder capacity so much in excess of daily needs as was formerly thought necessary.

There is a disposition among present day writers, supplemented by the opinions of men advanced in the business, to substitute another standard for the one so long in use, and the one we have held so much in reverence, to wit: candle power; and to substitute therefor, heating value, or the heat unit. And with this disposition, comes the suggestion of a lower illuminating power; and why not, since the tendency is almost universal toward the use of the Welsbach burner or some other type of incandescent gas burner. Why, unless compelled by some legislative act, is it necessary for us to distribute to our consumers, a gas of say twenty (20), twenty-two (22), twenty-four (24), or even higher illuminating value, when, with a gas of say fourteen (14), sixteen (16), or eighteen candle power and the use of the Welsbach, or a similar type of burner, there can be obtained nearly equal results for our consumers, and certainly increased benefits to ourselves. We may not at once agree with Prof. Macadam who, in a lecture before the North British Association of Gas Managers, says, in referring to the Welsbach burner "The light is not obtained from the constituents of the gas, except indirectly from the heat of combustion; a perfectly non-luminous gas, or a very low candle power gas, provided it, in burning, gives a sufficient amount of heat, should furnish just as good a light result as a high quality gas;" and yet the statement is undoubtedly true. If, therefore, as seems to be a fact, the tendency is for a new standard, it behooves us to keep in mind any legislation bearing upon this question; or for those of us anticipating in the near future, a renewal of franchises, or the seeking of new ones, to see to it that the standard agreed upon, whether it be a lighting or heating value, is such as will enable our enjoying the benefits which seem now to be in the air, and which, though to some, may seem a step backward, yet in the "march of progress" are destined to be upon us before, possibly, we are prepared for them. There is much that may be said in favor of such a new standard as has been referred to, and a lower candle power, but both have already received the attention of eminent writers, and enough remains to furnish material for a paper by some member of the Association who has given the subject more thought and study than is indicated by the brief allusion I have herewith made to it.

The past year has been a notable one for extensive improvements and repairs, both at works and to our distributing systems; this is explained by reason of great reductions in the prices of all materials entering into the construction of new work; also because all work that could possibly be postponed last year and the year before, was held up on account of these high prices; also because the constant growth of our business has made it imperative that we be prepared to meet the increasing demands. Our distributing systems have been extended either for new business into new territory, or augmented so as to render better service in that territory already covered. In many of the cities and larger towns represented here, I believe both have been necessary, for there seems to be no limit to the demand for gas in our respective communities.

Naturally, we inquire as to the cause of this increased popularity in the use of gas; and we are compelled to answer that it is because of the neglected education of our consumers already secured and prospective; for we have only recently awakened to the fact that our business has not been conducted along the same progressive lines as have other manufacturing industries.

It has only been during comparatively recent years that we have exerted ourselves to find a market for our product; heretofore, we have devoted most of our time and energies toward securing economical results at our works by saving here and there a few cents, or, possibly, fractions of cents, in the cost of gas in the holder, believing that when this was done, coupled with some attention to leakage, we had performed our duty faithfully and well. Many of us are familiar with the methods formerly employed in computing the cost of our gas. The holder cost multiplied by two was generally considered as a reasonable estimate of the cost at burner; it is evident that such method would not now be a safe one to depend upon, for while the cost of manufacture has been greatly reduced in recent years, the cost of distribution has been largely increased, due to more liberal methods employed to secure and hold business; for we are ever on the alert for new schemes and ideas that will enable us to increase the sale of our product. Witness our efforts in this direction! We have offices that are a credit to any community, equipped with attractive furnishings and fixtures; we display gas consuming devices of all sorts, kind, and description, in a manner that is the envy of the retail merchant; and we employ competent salesmen and saleswomen, who are peculiarly and particularly adapted, not only to sell these devices but to give instruction in their use; we advertise our wares and their use in daily papers, and magazines; on bill boards, theatre programs, and in every other way that we believe to be judicious methods of advertising. We seemingly do everything to keep the use of gas before the people. We keep solicitors in the field the year around and can tell at any moment from the reports of these solicitors who, upon a certain street do not use gas and, why they are not using it. Encouraged by the knowledge that our product has passed beyond the stage of luxury to that of necessity, and coupled with the fact that the majority of us are selling at a rate that will enable everybody to use gas, which rate has either been established by ourselves as good business policy, or through compulsion brought about by local conditions; is it any wonder that the limit of our business and the territory to be covered, seems just as far off now as it did several years ago? The wealthy and the well-to-do classes in our respective communities are now supplied, except such as may locate and build later on; our business now, therefore, is to educate and supply those possessed of less of this world's treasure, and I doubt not but I express the opinion of most of you when I say that this is desirable business, and the kind that is worth looking after; because this class of people are masters or mistresses of their own households, use only what they can afford to pay for, and pay for what they have, and usually without complaint. In saying this much upon the question of selling gas, I realize that I am tresspassing upon a paper that will presently be presented by a gentleman who knows all about the subject assigned him, but I cannot refrain since it suggests other thoughts.

It is pleasing to contemplate that by the efforts put forth to introduce gas engines, stoves, ranges, water heaters, etc., we have brought our day consumption up to a point where, in many instances, it far exceeds the night consumption; and yet we must not forget that we are in the lighting business as well, and that no opportunity should be lost, either to hold old consumers or to secure new ones. We have had competition in the past with electricity that was disastrous to the companies furnishing it, because it was illegitimate, due to the then prevalent custom of selling current by contract, and therefore, with no very clear conception of the cost of supplying the consumer. I believe I am safe in saying that there has been a marked change in such methods, and that now, it is the exception, rather than the rule, where electric current is sold by contract. Electric companies have found out that, for their own protection, and as a business proposition, the only profitable way their business can be conducted is by the use of the meter. Hence, competition with electricity for light becomes a legitimate one; and, under the circumstances, our judgment is that gas companies have nothing, at present, to fear.

We must not forget that we are in the business of furnishing light, as well as fuel and power. That electric companies are upon a firmer basis than in the past cannot be disputed; and it is gratifying that it is so; they have also made rapid strides in the economy of operating, due to the general adoption of slow speed condensing engines, coupled direct to the dynamo; and by the installation of larger units; also the development of the polyphase alternating system, and the introduction of the enclosed arc lamp, particularly for street lighting. As a result, the electric plant of today can be designed on lines of greater simplicity as to system, and can attain far greater economy in operating.

The disposition to consolidate gas and electric properties in smaller towns and cities is, I believe, good business policy, inasmuch as the tendency to cut rates for either gas or electricity below what is profitable, is avoided, as under united management reasonable rates for either that will be profitable can be made and maintained.

It is in the field of light and power principally, that we meet our electric competitors, if such they can now be called; for we are disposed to believe that, as the years pass, the lines are not so tightly drawn; each has its sphere of usefulness, and each is making more rapid progress in the development of their respective business, and in the service given, than if either were in full possession. The situation is an extremely interesting one, and we look forward to the future, with a full realization that it will be necessary for us to understand and to take advantage of our opportunities.

Through the instrumentality of the Welsbach and other incandescent gas burners, we are able, by giving a superior light and a cheaper one, to more than hold our own, provided we give to the incandescent gas burner such attention as it requires to render efficient and satisfactory service; and in this connection, it is well to emphasize, what probably most of us have found out, that it pays to inspect the burners and mantles; and to undertake to keep out of the field anything and everything but the best. There is opportunity here also, for the education of our customers; if we could but establish their confidence to that extent that they would rely upon our statements as to the efficiency of certain burners as compared with certain others, and not be "buncoed" by traveling dealers, whose only object is to sell their burners without care as to the results which may follow, we would have achieved much in the right direction. This, I believe, will be accomplished in time, but it will require everlasting diligence on our part; and it means that we must keep the right sort of men in the field all the time, to assist in doing it.

If, in competition with the electric light, we can give more light for less money, it behooves us to look to the comparative convenience of gas; for we admit that for convenience in lighting and extinguishing, and for certain decorative purposes, the electric light is superior to gas light; but cannot the difference of convenience be reduced by the installation of electric gas lighting devices? These have been introduced in the larger cities, and more especially in the East, and in reality are no new thing, but in the smaller cities and towns, especially in the West, I doubt if they have received the attention to which they are entitled. I believe it would pay any well regulated company to have in its employ a man who is competent to furnish estimates and perform this class of work in conjunction with the house piping and fixture business.

Gas lighting, by means of chain by passes, is convenient, but not absolutely satisfactory, especially where used in conjunction with the Welsbach burner. So-called self lighters are on the market, but these must, and undoubtedly will, be improved upon before they can be generally used with satisfaction. The introduction of all such devices should be encouraged, and not too quickly condemned, for, be it remembered that the Welsbach burner would have been short lived if its early existence had depended upon the approval of its patrons, or the enthusiasm of ourselves. Its success was due to the energy and persistence of those who had faith in the future of the burner, and to them our thanks are emphatically due, that we are to-day able to perform so large a percentage of the lighting business.

It is pleasing to note that we are making progress in the introduction of gas engines, and while still handicapped on account of the first cost of installation as compared with the electric motor, yet, we are able, by reason of the smaller cost of operating per unit of power furnished, to place an occasional engine; and this occasional engine means the addition of others. To make satisfactory progress in this respect, my advice would be, to first select the best engine we have any knowledge of (not the cheapest), and beware of the engine that may be converted quickly from a gasoline to a gas engine, or vice versa, for they are not to be depended upon for economy; select from your force a man, if you have one, competent, not only to talk gas engine but who is also thoroughly posted in its operation; one who is able to figure the relative cost of operating with steam, electricity, or gasoline. Each engine installed should be inspected at intervals so as to discover any defects, if any exist, and to remedy them. In my experience, the average user of a gas engine has little regard for the cleanliness of the machine or the surroundings; in his judgment, it is necessary only to give it oil (any kind will do), to turn on the gas and let it go until he is ready to stop it; and the same method of operation is pursued day after day. It would seem, therefore, that our business from the time our product leaves the holder until registered on the meter dial, is one of education; education that means an expenditure of money, thought and energy, but which, in the light of present and anticipated results, will pay.

Referring briefly to the question of gas for street lighting which, for a number of years seemed to have been relegated to the rear rank, in the march of progress, is now, we are happy to note, gradually working itself to the front again.

The public, always in a receptive mood for the newest and latest things out, saw in the electric arc lamp a light that would convert darkness into day light; hence, cities and towns made haste to adopt this new method of lighting and generally without regard to cost. It has had its trial and served its purpose, to the extent, even, of displacing in many towns and cities, all the gas lamps originally in use; but it has been discovered that too much light in some places and none in others, and especially in the residence portions of cities, is not satisfactory; that the more even distribution of light by the gas lamp, and beneath the foliage, is preferable. And it has been discovered that where gas is employed that the bugs and insects, and "every creature which is * * * on the earth and under the earth, and such as are in the sea" do not reach that size and magnitude, and are not so numerous that they fall down in heaps to be carried away by the scavenger the next day

We admit that every arc lamp placed in the business portion of a city is equal to a policeman, and we are unmindful if companies furnishing them do receive as much compensation therefor as the average policeman receives, but in the light of the present day, we are not willing to admit that for residence street lighting the electric arc lamp, as usually placed, is the equal of good gas lamps placed at intervals of say, from one hundred (100) to one hundred and fifty (150) feet apart, having flat flame burners, and consuming at the rate of six feet of gas per hour; said lamps to be of an attractive design, kept clean, and in good repair. And this leads me to suggest that we are by no means dependent upon the flat flame burner for street lighting; for the incandescent gas burner enclosed in lanterns especially adapted for their use have made, through the energy of those introducing them, and because of real merit, very satisfactory progress; and I have it upon good authority that these have been placed in many of the larger cities of the country to a total number of 100,000, and with prospects for their continued rapid increase. I am sure that the satisfactory results given by these lamps may be attributed to the care and attention they receive, and it is evident from the number placed that they are giving satisfaction in communities where they have been installed. These lamps are placed at an average distance of one hundred and fifty feet apart, the price depending upon the price of gas in that city or town. Those of you who have seen a street lighted exclusively with Welsbach lamps know how favorable the comparison is to a street where electric arc lamps are used, especially if employed in a residence section.

Concerning acetylene lighting, I understand that the manufacture of carbide at Niagara Falls and the Sault Ste. Marie is being made in large and increasing quantities, indicating that there is a demand for it somewhere. It is probable that this demand comes from towns too small for the profitable operation of a coal or water gas works; and there being many such, little doubt need exist but that this industry has a bright future.

I understand that the gradual and continued reduction in the price of carbide makes it possible for acetylene to be produced cheaply enough to attract the attention of town councils for the lighting of streets and public buildings.

In passing it may not be out of place to mention that the question of electrolysis has received such vigorous attention in different parts of the country, that street railway companies are giving prompt and careful attention to their construction work, both on new lines and by the repairing of old ones, so as to obviate or reduce to the minimum, as far as present information will enable them, any electrolytic damage to underground pipes conveying gas or water.

The question of the taxation of public franchises is one that always confronts us, and like Banquo's ghost " will not down," yet it is strange that it should be a never ceasing source of trouble and discussion.

A franchise is simply a privilege, a right, and is not property. The State grants the right or privilege, which is an intangible something, and surrounds it with all those limitations and conditions deemed necessary for the protection of the public. After this is done, it immediately taxes, not alone all of the property belonging to the corporation holding the franchise, but taxes the very privilege it has just granted. The State, in granting the franchise, retains the right to control it and fix all charges in connection with it. The courts hold that the State retains the right to determine all charges and tolls, thus leaving the value of the franchise at the absolute mercy of every municipality; then, having done this, attempts to exercise the right of taxing, if necessary, this very public franchise out of existence.

In this way every corporation engaged in a public utility is subject to two methods of spoliation at the hands of municipal bodies. Does the treasury need money, the taxing body imposes a tax upon the franchise, as it sees fit. Do the people demand a reduction in the charge for gas, electricity or the like, the municipal authorities proceed to at once reduce the price to the consumer; so that the receipts are reduced at one end while the tax for the privilege to do business remains the same or is increased.

It is now conceded that the sovereignty retains the power to fix the charge for all public utilities at such reasonable figure as shall yield reasonable returns on the investment, not upon the investment with the value of a supposed franchise added. Yet while we are allowed to earn only a return on the actual value of the tangible property, we are taxed on the value of the franchise, for which we are entitled to no consideration in fixing our earnings.

It is clear from this that a franchise is not and ought not to be a subject of taxation. The privilege granted to furnish gas is for the benefit of the general public as consumers, and the public should have the benefit in the fixing of a reasonable charge for the commodity, and the municipality should not have the benefit in the way of a tax.

Much has been said and written of late concerning profit sharing, and Building and Loan Associations, for the benefit of employees, also methods and measures for the better care of working men employed in large manufacturing concerns in general, and in and about gas works in particular.

Many of us, I presume, have had a theory favorable to such a measure as the "better care of workingmen," but we must confess that the theory has been often shattered, and especially so in the light of recent events. We are led to believe, however, that there must have been something wrong somewhere, when the employees of such an institution as the one at Dayton, Ohio, employing twenty-three hundred people, surrounded by everything, seemingly, calculated to make the labor of an employee light and easy, the "model factory" of this country, should strike, for the reason that four of their number were discharged for cause. And yet, many of us looking back over the years when we were less fortunate than now, can say from experience, that we would have appreciated any effort on the part of our employers that would have made our burdens less heavy to bear. Gas Companies have not been, and are not now, hampered with labor or industrial unions; the men grow up in the business, are well paid and as a rule are satisfied. But, realizing the feeling of unrest on the part of labor in certain sections, the extent and importance of which seems to be growing with the commercial growth of the country; and the tendency in nearly every industrial pursuit to organize for so-called "protection," would it not be well for directors and managers of Gas Companies to seriously anticipate what is happening and to consider ways and means which will continue that friendly relationship which we believe now exists between employer and employees of Gas Companies in this country? Consider the men employed at the works, and especially in a works where coal gas is made, and it will not be disputed that their labor while intermittent, is nevertheless hard; and more intelligence is required than is possessed by some of them to know how to take proper care of themselves under existing conditions. They perform the duties assigned them, become heated, carelessly sit or lie down in a draught, and consequently, in disobedience of the laws of nature, they pay the penalty of such carelessness with shortened lives.

Why not set apart at our works, whether for coal or water gas manufacture, a room, ample in size, to which the men, as they may be spared from their labors, can retire; such a room should be equipped with lockers in which their good clothing, such as they would wear to and from their work, could be kept; each man being assigned his own locker, and to be held responsible for its order and cleanliness. In this room, or another convenient thereto, depending upon the size of the works, and the number of men employed, there would be a bath tub, and shower baths and other toilet conveniences; the foreman of each shift to be held responsible for the cleanliness at all times, of such a room and the appurtenances therein. We might go even farther, and provide facilities with which they could heat their tea and coffee, or other articles of food requiring heating or cooking.

In addition to these we could reserve, if only a small portion of the yard, space where grass could be grown and kept green, with a few shrubs scattered about, and possibly, a few flowering plants. No man, fit to be employed about such an establishment, could but appreciate these things, and the expense in keeping them up would be insignificant. This condition of affairs, I know, would be in striking contrast with many of the works we have in mind; for, sad as it may be to relate, there are gas works in this country that we know of, whose management do not provide even decent tools with which to perform the work; and the results there are usually commensurate with what the workmen have to do with.

This liberality on the part of the management might gradually be extended to the office and shop employees, especially if both office and shop were in the same building, by the setting apart of a suitable room, neatly and substantially furnished, equipped with a billiard or pool table, or both; also a library table upon which could be found the daily papers, and some of the leading magazines and technical journals, such as relate to mechanical and scientific questions, and to the gas business. Here employees could congregate evenings to read, smoke, or talk, and in other ways amuse themselves. Such a room, once established, I am sure would be willingly maintained by the men making use of it, by small monthly or weekly subscriptions. The limit to which such a room and its contents could be extended would depend, of course, upon the number of employees to enjoy it. The question you are undoubtedly asking yourselves is, would all this pay,—would it be appreciated? Why not try it and find out, the experiment may be tried in piecemeal and would not cost much.

Mr. Nettleton, in his admirable address in 1897, referred incidentally to profit sharing; this is by no means a new question, for it has been successfully tried by large manufacturing concerns in

Europe and, in few instances, in this country. The only gas companies I know of as having given any plan a trial are the Columbus Gas Company of Columbus, Ohio, and the Grand Rapids Gas Company, Grand Rapids, Michigan, upon a plan devised by Mr. Emerson McMillin. This plan consisted of "additional compensation for continued and faithful service" in the shape of non-interest and non-dividend bearing scrip, which scrip was redeemable only in the shares of the capital stock of the company, when presented in sums of $100.00 or any multiple thereof;" provision being made, "that when any employee shall have received from the company direct or have acquired by purchase from others, the aggregate sum of $300.00 of such scrip, such employee may then, so long as he continues to hold such scrip or the equivalent in the stock of the company, at his option receive any further reward in cash." I understand that the plan, in that comparatively few of the employees of the company became actual stockholders, was not altogether satisfactory, yet "the effect of the plan was good, both upon the employee and to the credit of the company in the community." This plan, while worthy of commendation, is not, it seems to me, altogether the right one, inasmuch as it admits of the barter and sale of the scrip, in which transaction, the more shrewd individual would receive the benefits which were not intended for him. A plan that would give quicker returns in the shape of non-transferable stock or scrip, upon which dividends would be paid in cash, or the actual payment of cash, would, it seems to me, put the matter in such shape as to give those the benefit whom we were seeking to reward. Would not some plan as would make an officer or employee of a company feel that he had an interest in his employer beyond that which he had to give in return for his compensation, be desirable?

The question of profit sharing suggests also the establishment of Building and Loan Associations for the benefit of employees; and like the other is not altogether a new idea, although I am not advised that such an organization has been created for the benefit of the employees of gas works, except in St. Louis, Mo. I understand that there an association was started primarily for the benefit of employees of the company, but as they could not subscribe for all of the stock, outsiders were permitted to come in on the same terms. The admission of outsiders is, it would seem to me, an objection to the plan, and, if necessary to the success of the association, I would consider such a plan not as desirable as some other that might be devised. The purpose of this association was the accumulation of a fund from monthly dues, premiums, interest, fines, etc., which fund should be loaned to its members, or to persons not members, for the purpose of enabling them to erect or purchase homes; I understand that the following, in brief, is what was accomplished in part at the end of the first one hundred months, omitting all outside stockholders: "Five (5) employees cleared off mortgages amounting to $17,200.00, the interest paid by them to the association for loans averaging three and one-fourth (3¼) per cent. Fourteen (14) employees who did not borrow on their shares realized $11,803.56, paying them an average of nine (9) per cent. for the time their money was invested. Twenty-one (21) employees have loans aggregating $37,600.00, and seventy-five (75) employees own seven hundred and ninety (790) full shares representing, an investment of $30,000.00." "And this does not represent the amount to which the association has been patronized by the employees, because so many of them remained in for the purpose of accumulating a little money, and then drawing it out to use for other purposes than building." Many of the members admit that they would have had nothing to-day were it not for the dues paid in. An association of this kind certainly tends to keep the men satisfied, for they feel that their interests are being cared for and the little money they are able to save is safely invested, while others would never have obtained a home but through this method.

I have referred to this one association with which I have acquainted myself, for I believe it is worthy of consideration and possibly of imitation.

In line with these suggestions it certainly will not be out of place to refer to that most excellent work inaugurated and now being maintained by this Association; I refer to the School of Correspondence. This is, without doubt, the best work carried on by any similar association in this or any other country, and stamps the American Association as being in the lead of all others in doing for the young men in our employ what they can but appreciate; for it presents opportunities of inestimable value and such as many of us would have so enjoyed the benefits of in our early experience. The work of this correspondence school should never be allowed to lag for want of support, and when the time comes for the renewal of subscriptions, I am sure that there will be no difficulty in realizing even more money with which to carry on this work than when the plan was first promulgated.

The establishment of an Association library is to be commended, and every assistance possible should be given the Secretary to help carry on the work of what now is but the nucleus of that important part of our Association, for it will assist materially in its permanency.

There will be a report made here by a committee appointed one year ago upon the question of some general policy of advertising, and I shall endeavor to have it brought up sufficiently early so that it may receive your thoughtful and candid consideration. Briefly, a similar committee was appointed by the Ohio and Western Associations, and these committees have made their reports. The plan is to devise some satisfactory method by which knowledge of the various ways in which gas can be used will become universal; and by which means every company contributing will be benefited by the experience of those who know how to advertise. In some such way as may be proposed all are benefited in general, and each in particular.

In this connection, it appears to me that it would be advisable for this Association to take steps at this meeting looking toward some concerted action on the part of builders of gas apparatus and manufacturers of gas consuming appliances, to make a creditable display at the World's Exposition to be held in St. Louis in 1903; and I recommend the appointment of a committee of five (5) whose duty it shall be to represent this Association and to co-operate with other gas associations, if need be, to secure space in which there shall be a display of all gas making and gas consuming devices, of all the manufacturers who may be prevailed upon to enter. It might not be practicable for gas making machinery to be erected, except in miniature, or by models, but the whole scheme appeals to me as one that would attract the attention of the public, and would be a most excellent exemplification of what the condition of the gas business in this country is at the present day. It is not difficult to imagine that arrangements could be made whereby great good may be derived to all concerned by such a display as I am sure could be made.

Death has placed its hands heavily upon the membership of our Association during the year, having removed from our midst eight

(8) active and two (2) associate members. In their passing the Association has lost men of character and high standing, not alone in their respective communities, where they were best known and most highly honored, for in more than one instance the influence of their lives has extended beyond the confines of locality; their faces and forms were familiar upon occasions like this; we miss them now and we shall continue to miss them, especially upon each recurring anniversary.

W. G. Abel, for many years Superintendent of the Atlanta Gas Company, Atlanta, Ga. He joined the Association October 20, 1886; died December 21, 1900.

A. C. Gandey, Superintendent of the Lambertville Gas Company, Lambertville, N. J. Became a member of the Association October 2, 1891; died December 30, 1900.

Harold Humphreys, New York City, N. Y. Associated with Messrs. Humphreys & Glasgow. Joined the Association October 18, 1899; death occurred February 12, 1901.

David W. Crafts, Superintendent Northampton Gas Light Company, Northampton, Mass. One of the Association's oldest members, having become a member October 20th, 1875; death occurred March 12th, 1901.

Chas. C. Fry, Treasurer Lynn Gas Company, Lynn, Mass. Joined the Association October 17th, 1883; death occurred March 21st 1901.

William Stacey, Vice-President Stacey Manufacturing Company, Cincinnati, O. He joined the Association, October 19th, 1887; death came June 17th, 1901.

James Slade, Superintendent Yonkers Gas Company, Yonkers, N. Y. Joined the Association October 17th, 1883; died June 18th, 1901.

George B. Neal, Treas. and Manager Charlestown Gas Light Company, Charlestown, Mass. One of the pioneers of the Association, having become a member May 13th, 1874; death occurred July 7th, 1901.

William E Barrows, President Welsbach Company, Philadelphia, Penn. His membership dates from October 1889; death occurred July 30th, 1901.

William W. Goodwin, President Goodwin Meter Company Philadelphia, Pa. Another founder of the Association, having become a member, April 16th, 1873. Died, October 6th, 1901.

In this list of the dead of the year, members of the Association will observe the names of many veterans in the great enterprise which our Association represents; they have gone to their reward, full of years, full of honors, leaving untarnished names behind. However, there is one name, that of Humphreys, whose mere mention will bring tears to the eyes of those present who will recall his tragic death in the Nile while struggling to save his younger brother. He died in an attempt to save a life. He paid his last full measure of devotion; he laid down his life for his brother. A mere youth himself, athletic and strong, educated and brilliant, on his bridal tour, his death could not have been more tragic. The world was all before him. I have deemed it proper to make special mention of this brilliant youth taken from us in the morning of life.

I cannot refrain from expressing to you, at this time, my appreciation of the great honor I have at being selected for the brief period allotted, to preside over your deliberations and I shall endeavor to give evidence of that appreciation by assisting, in the capacity that has been given me, in making your sojourn here a profitable and an enjoyable one. And I desire, also, to extend my thanks, and to express my obligation, to the gentlemen who have so kindly contributed papers; for I realize that in nearly every instance these papers have been prepared from personal interest and a desire to aid in the success of this meeting.

THE CHAIRMAN:—You have listened to a thoroughly practical and very excellent address. What is your pleasure?

MR. WM. HENRY WHITE:—I move that it be referred to the usual Committee for report at this session.

Carried.

THE CHAIRMAN:—I will appoint as that committee:

A. B. Slater,
W. H. White,
W. L. Cosgrove.

The President resumed the chair.

THE PRESIDENT:—Is the Committee on Nomination of Officers ready to report?

Mr. Nettleton read the following report:

The Committee on Nominations desire to report the following names:

President	William R. Beal
1st Vice-President	Alten S. Miller
2nd Vice-President	Rollin Norris
3d Vice-President	Edward G. Cowdery
Secretary and Treasurer	Alfred E. Forstall

Members of the Council to serve for two years:

Charles R. Faben, Jr.,
Walton Forstall,
C. J. R. Humphreys,
Edwin E. Witherby.

Charles H. Nettleton, *Chairman.*
Thomas Littlehales,
William H. Gartley,
Henry L. Rice,
Isaac C. Baxter,
Committee.

On motion of Mr. White the report was adopted, the Committee dismissed with the thanks of the Association, and the Chairman of the Committee was instructed to cast the ballot of the Association for the election of the officers named. Mr. Miller acted as teller, and reported a unanimous vote for the election of the nominees; and the President declared them duly elected officers of the Association for the ensuing year.

The President:—You have elected the gentlemen whose names have been read, officers for the ensuing year. The incoming President, Mr. Beal, is present, and we would like to know if he has anything to say at this time.

Mr. Wm. R. Beal (New York City):—I thank the gentlemen of the Association from the bottom of my heart for having conferred upon me what I consider to be a very great honor. I pledge you my best efforts during the year in which I am to serve you, and I hope that I will be able to serve you successfully.

The President:—We would like to hear also from the first Vice-President, Mr. Alten S. Miller.

Mr. A. S. Miller (New York City):—Mr. President and gentlemen: I appreciate more than I can say the honor that you have done me, one of the younger members of the Association, in electing me to this office, and, as I have always tried to do my best for the Association, so I hope with the assistance of the members to be able to do something for it in the future.

THE PRESIDENT:—The second Vice-President, Mr. Rollin Norris.

MR. ROLLIN NORRIS (Philadelphia):—All I have to say is that I hope my work for the Association may prove acceptable.

THE PRESIDENT:—Mr. Edward G. Cowdery, the third Vice-President.

MR. E. G. COWDERY (Milwaukee, Wis.):—I thank you for the election, but I think you had better allow the third Vice-President a few years to make up his speech.

THE PRESIDENT:—Is the Committee on Uniform Accounts ready to report?

MR. A. C. HUMPHREYS (New York City):—I would like to say, before commencing to read the report of the Committee, that the papers being distributed are sample sheets from the classification schedule, and are designed simply to give you an idea of how the schedule will be prepared. These sample sheets are selected out as representing two different classes. One of them gives an instance of the *special* journalizing instructions to be referred to, and the other may be of special interest to the members as indicating how the Committee would propose to classify the expenses and dues of members who attend these meetings.

REPORT OF PROGRESS.

COMMITTEE ON UNIFORM SYSTEM OF ACCOUNTING.

To the American Gas Light Association:

GENTLEMEN:—Your Committee was appointed under the following resolution passed at the last meeting:—" Resolved: That the present presiding officer appoint a committee of three to consider the question of a system of uniform accounts for gas companies, to co-operate with other committees of a similar nature from other public service corporations and report their recommendations to this Association."

This resolution was passed in response to the earnest recommendation contained in Mr. Ramsdell's presidential address and all the members of your Committee felt it their duty to accept this appointment because their experiences had convinced them of the urgent need of reform in this direction.

An efficient system of book-keeping should provide for the keeping of complete records of all business transactions whether involving or not the direct transfer of money.

The books so kept should be completely self-explanatory. Too often entries are so made as to be only understandable by those who made them. Memory or unrecorded information should have no part in such a system.

Finally the test should be, the capacity of the books as kept to show the final result of the business for any selected period.

Especially should the system be designed and operated to provide against the improper application of profits and the payment of dividends not earned.

But something more than final results should be obtainable from such a system. The operating accounts should be so sub-divided in accordance with the nature of the business as to furnish the ready means at all times for the exact analysis of operating expense and the locating of all uneconomical methods.

In a business such as ours, this means the keeping of the ordinary books of account and also of supplementary or statistical books.

But such a system as your Committee has been charged to report, must go still farther and be so comprehensive as to be capable of general adoption by gas companies—in other words, it must provide for the *uniform* analysis and comparison of accounts.

In connection with our Association and other conferences and with the conduct of a united scheme of management, now such an important and growing feature of the gas business of this country, it is of prime importance that the accounts should be so kept that the cost of gas delivered to the consumer's burner should be so subdivided as to provide for this uniform analysis and comparison, step by step through the works, the streets and the office.

Not only would this be of great practical value in operating, but it would also render it more difficult for irresponsible parties to find an apparent basis for claims impossible of verification as to cost of gas.

Each member of your Committee appreciates the magnitude of such an undertaking, for all having had experience in the management of united companies, they have found that even where all the companies are subject to uniform instructions and control, the absolute uniformity of accounting is most difficult of attainment.

This is here stated not to discourage the present attempt to provide for general uniformity, but to point out that there are necessarily difficulties hard to overcome by reason of the great variety of local conditions as well as the *general difficulty of securing a uniform interpretation of all rules and instructions.*

As the natural basis for a system of operating accounts should be a division of the expenses through a sufficient number of accounts to facilitate an accurate analysis of the cost of manufacturing and distributing the gas and the other expenses incidental to the business, and as any system of uniform accounting must primarily depend upon the adoption of a uniform system of classification, your Committee first took up this part of the work.

While considerable has been done, even this part of the work has not been finished, but the Committee feels that it is proper at this time to report the results so far obtained and suggest that if it meets the wishes of the Association the Committee can be continued under conditions that will give it the advantages of the criticisms of the members of the Association before making its final recommendations.

Your committee therefore asks permission to submit the result of its work to date which is shown by the classification schedule, instructions for use of same, instructions for journalizing, etc. herewith*, with the further suggestion that between now and the first of January next your Committee shall print its tentative recommendations and that the same be sent out to all the members of the Association with a request for criticisms by mail to be received by the Committee not later than the first of April next.

Your Committee then expects to prepare for final submission to the Association at its meeting in October, 1902, a classification schedule with accompanying instructions, instructions for journalizing, and the necessary forms for vouchers, time sheets, pay rolls, store-room records and the like, necessary or desirable for the proper carrying out of the system. It is probable also that the Committee would then be prepared to submit forms for itemized monthly and yearly statements of costs and profits.

If your Committee, with the concurrence of the Association, so proceeds, it will do so with the understanding that it is to receive the active co-operation of the members of the Association along the lines above outlined.

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* As the classification sheet and instructions were still subject to revision and in fact it was almost certain that they would be changed in some particulars, it was thought best not to publish them in the Proceedings until next year, when all the corrections will have been made.

While some members of the Association may feel that they are not qualified to completely criticise such a comprehensive scheme of accounting, your Committee knows that there are many members of the Association well qualified to do so at every point and that all the members are qualified to advise at certain points. Your Committee desires to avail itself of the advantage of as many points of view as is possible.

Your Committee has not so far considered it advisable to confer with other bodies engaged on like work, for the reason that until they had arrived amongst themselves at something more like a final conclusion such outside conferences promised confusion rather than results.

Your Committee recognizes that for lack of time it will now be difficult to give the Association a complete view of the work so far accomplished, but they feel warranted in asking for sufficient time to give a general outline of the classification system so far agreed upon.

In preparing the classification schedule, the Committee has deemed it wise to first consider the needs of the larger companies. The result will be known as the Senior Classification Schedule. Later it is proposed to prepare a Junior Classification Schedule, which will contain the general accounts as in the senior scheme, but these general accounts will not be sub-divided to the same degree.

While this will not provide for a complete comparison in detail between a company employing the senior schedule and one employing the junior schedule, a fair comparison can be had on all the general items of cost. This will be better understood when the senior classification schedule is studied.

It is here well to consider that the smaller companies will prefer to compare their costs with other smaller companies. If the senior classification schedule were pronounced by any one company too elaborate for its adoption and an independent modification thereof were developed, it is needless to point out that all opportunity for comparison through a uniform system would be at once destroyed; whereas by the system of modification we suggest, the same general classification will be available.

The classification schedule as herewith submitted is not intended to be complete. Gas and other sales accounts, sundry creditors, etc., as required for a complete statement of assets and liabilities and especially of quick assets and Floating Debt will be included later in connection with the revision before referred to.

It is proposed to adopt the following general divisions for the operating accounts:

MANUFACTURING—To include the cost of gas to the outlet of the works.

DISTRIBUTION—To include the cost of gas from the outlet of the works to the outlet of consumers' meters.

COMMERCIAL EXPENSE—To include the cost of reading meters, collecting and accounting.

EXPENSE—To include general items not strictly applicable either to manufacturing or distribution.

NEW BUSINESS—To cover advertising, canvassing and other expenses incidental to the extension of the business either through sale of appliances or otherwise.

Taking these five accounts as the General Heads, the classification schedule provides for Sub-accounts, as shown below.

Under the heading of each sub-account is given, first, general directions as to the scope of the account; second, a list of the items chargeable to the account, in sufficient detail to enable any employee without special bookkeeping experience to determine upon reference to the classification schedule, to what account any particular item is chargeable; and third, where necessary, *special* directions for journalizing.

(General Accounts.)

Manufacturing.

(Sub Accounts.)

Ammoniacal Liquor Expense
Coke Expense
Tar Expense
Ammoniacal Liquor Residuals
Coke Residuals
Tar Residuals
Boiler Fuel
Expense Works

Manufacturing—Continued.

Fuel Under Retorts
Gas Coal
Generator Fuel
Manufacturing Labor
Oil
Purification Supplies
Purification Labor
Repairs Works
Repairs Works General
Water Tax
Gas Storage Expense.

Distribution.

Distribution Expense
Distribution Labor
Repairs Mains
Repairs Services
Repairs Meters
Street Lamp Operating

Commercial Expense.

Expense Collection
Expense Office
Office Salaries

Expense.

Accidents and Damages
Expense General
Expense Extraordinary
Insurance
Interest
Litigation
Association Meetings
Salaries General

New Business.

Advertising
Appliance Demonstrations
Gas Appliances
Gas Engine Expense
Gratuitous Work
House Fitting Expense
Expense Soliciting

Further, it is proposed to employ the following Stock Accounts:

Ammoniacal Liquor
Coke
Tar
Store Room

It is proposed to open each month accounts for:

Expense Stable
Expense Store Room

which accounts will be closed out at the end of each month into the various accounts for which work was performed, each account to bear its percentage of the total expense during the month.

It is proposed to include the following accounts under the general heading

Miscellaneous.

Taxes
House and Land Rental
Interest on Bonds
Interest on Borrowed Capital

In addition to these operating accounts it is proposed to adopt the following betterment accounts:

Betterments.

Extension of Street Mains
Extension and Improvement
Street Mains——Inch Extension
New Meters
New Services
Street Lamp Extension
Real Estate
Street Main Replacement.

For convenient reference the accounts will be numbered either in one series or as many series as there are general accounts.

It is then proposed to further explain the system and eliminate ambiguity as far as possible by general instructions and instructions for monthly and closing entries.

Recognizing the difficulty of avoiding all ambiguity, your Committee in all of its work and especially in the preparation of its remarks and guiding notes aims to make its recommendations self-explanatory, even though in so doing they may be criticised for considering the subject from too elementary a standpoint.

It will be particularly noted that betterment charges (especially in the case of main laying) are provided for by special authorization accounts. This perhaps suggests only the requirements of a united system of management. But your Committee holds that even where an authorization does not first have to be obtained from an outside managing body, there should still be the record of an authorization of each extension of plant.

Even if the executive officer is given the authority to pass upon such work without submission to superior authority, for his guidance a careful estimate of cost and probable income return should be prepared and when so prepared it must be to the advantage of the management to record the authorization in due form for future reference. Even in such a case it must be of distinct advantage to have a ready means of checking up the estimate with the final cost.

Furthermore, in the case of main laying, before passing the individual or authorization extension accounts into the general extension account, it is designed to pass them through accounts designed to show separately the cost of all the pipe laid during the year, grouped according to size. It must be seen that this will be of value to the single company as well as to the companies of a united system. Such a system must provide for increased accuracy in the preparation of estimates and for comparisons in construction cost.

If it is considered undesirable to cover all these subdivisions of betterment accounts in the general ledger, a supplementary authorization ledger might be employed, the general ledger then to only cover the final betterment accounts.

It will also be noted that the system herein recommended depends upon a comprehensive and efficient system of store room records. As already noted, it is the purpose of the Committee to include in their final report a recommendation in this connection. The Committee recognizes that great care must be here exercised to secure a practical system which will be efficient but not cumbersome.

To facilitate the present consideration of this partial report, a limited number of selected sample sheets from the classification schedule have been prepared and are available for reference by the members present.

(Signed,) ALEX C. HUMPHREYS,
LEWIS LESLIE,
A. P. LATHROP.

The President:—You have heard the report of the Committee. What is your pleasure?

Mr. F. H. Shelton (Philadelphia):—It is very evident from the fullness and thoroughness of the report of the Committee that a very long step has been made towards that most desirable goal, a uniform system of gas accounts, which we have all wanted in the past, but which none of us have had—especially for purposes of comparison. I believe the subject is open for discussion, and the Committee have asked that the various side-lights be thrown upon it, so that they may have all the help they need in their work. I want to particularly emphasize one point which the Committee has not in the least overlooked, but has called attention to, and which to my mind can not be too strongly emphasized, and that is the proper boiling down of the accounts, as is proposed, for the use of the smaller companies. The Committee has pointed out the senior and junior, or the major and minor classifications, so to speak, and the forms of procedure which will be necessary; and it has further pointed out that if the smaller companies should themselves cut out, or leave out such portions as any of them may see fit, or think unnecessary, the results would be a hodge-podge, because no two of the smaller companies would retain or drop the same matters. There are probably twenty of the so-called smaller companies as compared with one of the larger ones; and it seems to me very desirable to make the report applicable to the smaller plants so clear, so condensed and so simple, if possible, that it will naturally be acceptable to the smaller companies, instead of being antagonistic to them. Many of the smaller companies are disposed, according to my observation and experience, to avoid as much bookkeeping as possible; and I think therefore it is very desirable that the system of accounts proposed should be made so complete, and at the same time so simple and clear, that no small company can fail to see the simplicity, desirability and practicability of the plan proposed; so that the reports can be taken up by them as well as by the larger companies, to whom what is proposed will be comparatively clear and comparatively easy to adopt. I move that the report of the Committee be received, and that such recommendations as are contained in it be adopted and authorized by the Association, and that the Committee be continued, to report next year on the lines proposed.

Carried.

THE SECRETARY:—I would like to remind the Association that by this vote the members have adopted the recommendations of the Committee, one of which is that the members send in before a certain time, such criticisms to the report as they may have to make. I have seen a good many of those resolutions adopted, and usually it has been pretty hard to get the members generally to respond to the request. I hope in this case it will not turn out so.

MR. C. H. NETTLETON (Derby, Conn.):—It seems to me that this report ought not to be dropped in this way, with so little or no praise. Speaking for myself, I would be very glad to see brought about uniform methods in accounting, and particularly such a complete method as has been reported by the Committee.

Those of you who are at all familiar with Mr. Humphreys' work know that he is and has been connected with a great many gas companies, and that he brings to this matter a tremendous amount of experience compared with the average man in our business. He has given to this and other associations the benefit of that experience freely and willingly, and it does seem to me that we are under very great obligations to him for his kindness, and also to the other members of the Committee for the part that they have taken in the preparation of the report, and for the free and liberal way that they have given of their also large experience.

Those of you who are connected with the larger combinations know about accounts kept by this or similar methods, but for those who, like myself, are connected with individual companies, and who have not kept their accounts along the lines proposed by the Committee, I think I can say that we have often wished it were possible for us to do so, and especially so when we have seen the elaborate and apparently very complete monthly and yearly reports which are the natural result of these methods.

I understand that the one thing which might almost be called the key note of the system, is the keeping of a "Store Account." Personally I have disliked that account, for the reason that it seemed to involve an enormous amount of work and consequent expense.

Only recently one company with which I am connected adopted it, acting on the advice of an expert whom many of you know, and in justice to the expert, I ought to say that I consented to its adoption certainly against my prejudices, and almost against my judgment. After having used it for several months, I would like to say for the benefit of those who have never tried it, and who now feel about it as I did a few months ago, that while it does involve considerable work, yet it is not so much as I had supposed, and the expense is not so great, and that the results obtained by reason of keeping the "store account" and everything that naturally goes with it, are extremely satisfactory.

Mr. E. E. Witherby (New York City):—I would like to ask if the subject of accounting in Massachusetts has been taken up for consideration. There are probably more companies, large and small, to the square mile of territory in New England than in any other place; and the laws of Massachusetts particularly are very rigid in reference to accounts. Have the Massachusetts Commission been seen? Have they considered changing from their present plan to the standard accounts adopted by the Association?

Mr. A. C. Humphreys (New York City):—We have, of course, had this problem brought before us, and have given the matter a little consideration. I think we are forced to see that it is our duty to report to this Association what in our opinion is a complete and proper system. Then we had to do either one of two things—either report the Massachusetts rules back to the Association as our recommendation, or to report without regard to any such restriction. I think that the members of that commission will not misunderstand me, but will receive the statement kindly if I state that they probably credit us with knowing in detail more about gas accounts than the Commission. We have had the necessary experience; we have passed our lives in the business; it is our calling; and it did not seem to us that we could for a moment think of blindly adopting those or any other rules. We did study them, but found that we could not accept them and so report to this Association. It is not necessary at this time to point out our reasons for this position. As to what you are going to do if you adopt our final report and put the seal of this Association upon it, and what you will do in Massachusetts, is another problem. I do not know what you are going to do—or whether the door is open in Massachusetts to have any change authorized. It does seem to me that if we can have our system adopted we would then stand the best chance of getting a uniform system of accounts for Massachusetts. At the worst the Massachusetts reports could be readily made up from our proposed system.

I would like to say, before sitting down, that it would be very unjust for me to accept without some protest all the credit for the work so far done. I have had in the Committee the most active co-operation of Mr. Lillie who, as Treasurer of The United Gas Improvement Company, is now connected with many more companies than I am, and who necessarily has had very wide experience; who is a professional accountant trained in this particular business, and who has done a large part of the work of this Committee. In this he has been assisted by his auditing staff. The third member of the Committee, Mr. Lathrop, has done everything that he could do by mail; and he has also had an unusually wide experience, and is a man of most excellent judgment in these matters. So I may say that this report is not the work, as is often the case, of the chairman alone, but is the work of the Committee as a whole; and I may say I have never been on a committee where this was more the case than in the present instance.

Mr. F. Egner (Norfolk, Va.):—I think it quite proper to move a vote of thanks to the Committee for presenting this report. I think the work which has been done has been enormous. I tried to bring out something similar to that before the Western Gas Association, some years ago, but it was voted down because the President of one of the Associations said that he did not want to have his accounts so simplified that anybody could go over them and find out all about them. I am very glad the American Association has brought this matter up. I have had some experience in such accounts and I know that it is far more simple than it sounds, when you hear the explanation. It is a step in the direction of simplifying accounts. I move a hearty vote of thanks be extended the Committee for its services.

Carried.

The President:—An innovation has been made in this meeting to which I desire to call your attention. You have probably observed somewhere in this room, or in the corridor of the hotel, a gentleman decorated with a badge. He is the Sergeant-at-Arms. This Association has never had one before, but there have been times and circumstances when it has been almost necessary to have such an official. It is not the desire of the Association, nor the desire of the Council to coerce anyone; but the appointment of this gentleman has been made for the purpose of assisting the Association, and assisting the President in keeping quiet and order in the room, and to remind gentlemen when it is time for the Association to convene. That is the real object of the appointment. I can assure you that the only weapon which he carries about with him is the badge.

The Association took a recess until 2 P. M.

AFTERNOON SESSION.

The Association met at 2 P. M.

THE PRESIDENT:—The first business in order this afternoon will be the presentation of regrets from absent members.

The Secretary read letters and telegrams expressing regret at inability to be present at this meeting, from Mr. W. H. Baxter, Mr. Doty, Mr. Lathrop, Mr. John Young and Mr. George McLean.

THE PRESIDENT:—The next business in order will be the report of the Research Committee. Is that Committee ready to report?

MR. A. S. MILLER (New York City):—Your Committee has individually been very busy this year on other work, and has not been able to devote to Research work the amount of time that the work deserves. At the same time they have tried to accomplish something. They have had for some years a number of set subjects; and bearing on one of those subjects a paper is to be produced at this meeting which will be discussed in its turn. The special work that the Committee has been doing this year has been on the standards for flanges and street main specials, and street main hubs. A number of experiments have been undertaken, and it was expected that the results of these would be given to this meeting; but they open up what seem to be very important leads; and it was decided that it would be better to postpone a report until the experiments are completed. Mr. Walton Forstall will present a short topic, in which he compares the standards that he is using with the Association standards. I wish to say that the members of the Association seem to feel that when this subject has been referred to the Committee, it has been disposed of for all time; and that henceforth they are relieved from all responsibility in connection with it. This Association has a set of standards which are either right or wrong. If they are right, they ought to be used; if they are wrong, it is the duty of the members of this Association to communicate with the Committee which has them in charge and to tell them wherein the standards are wrong. That is the only way in which the members can absolve themselves from responsibility; and as supporters of this Association it is their duty to do everything they can in that direction. Referring again to the subjects of the papers, I would say that the members of the Association are apt to feel that all of their duty is done when they appoint a Committee to hunt up subjects for the papers; and apparently they expect the Committee to do all the work in developing these papers. Some of the members have facilities for investigation, and they should come forward and give us a paper, and help the Committee along. The Committee has not done all the work it might have done, but at the same time it has been working more or less steadily for several years, and with not very much co-operation generally from the Association. It is to be hoped that in the future the Committee will be able to do better work than in the past, and they earnestly hope that in this work they may have the assistance of the Association.

THE PRESIDENT:—You have heard the report of the Research Committee. What is your pleasure.

MR. C. H. NETTLETON (Derby, Conn.):—I move that the report be accepted, its recommendation adopted, and that the Committee be continued.

Carried.

THE PRESIDENT:—I will appoint as the Committee, on the next place of meeting: E. H. Jenkins, Thomas Littlehales and A. S. Miller.

I will ask Mr. Moses if he is ready to report, as a member of the Committee representing this Association, in the matter of advertising? Or, would he prefer not to make that report in advance of reading his paper?

MR. F. D. MOSES (Trenton, N. J.): I would prefer to make it after.

THE PRESIDENT:—Very well. We will now take up the paper written by Mr. Frank D. Moses of Trenton, New Jersey, entitled "What is the Business of a Gas Company?"

(For paper see Appendix, page lxx.)

THE PRESIDENT:—You have heard a paper by an energetic and successful man in the matter of selling gas, and the paper is before you for discussion. I desire to say at the outset that I hope gentlemen will feel perfectly free to stand upon their feet and give expression to their thoughts; and I especially urge our new members to improve the opportunity given them here to express themselves. No one realizes more than I do the difficulty, or the diffidence, that one sometimes feels in standing and giving expression to those things that we may like to speak of; and I can say to you at the outset that you have my sympathy. I trust you will feel perfectly free in talking at this meeting. I am going to call upon one of the new members at the outset—Mr. Clabaugh, of Omaha, Nebraska.

Mr. G. W. Clabaugh (Omaha, Neb.):— Mr. President, and gentlemen, I am here to learn all that I can about the gas business. I am sorry that this gentleman has written only upon fuel gas. He must not forget there is such a thing as illuminating gas. There is one thing that I would like to have brought out here, now, or in future—and no doubt some one may patent it—but whether it is patented or not, it is very important that we should have a good by-pass which can be used for incandescent lamps. The by-pass which is being used with the Welsbach burner is a poor affair, but I think we ought to use the by-pass in every connection. It means an expense of only four or five cents a month, and it is a pretty good investment. But the by-passes that are now on the market are without doubt the poorest contraptions I have ever seen. They are so hard to adjust, and so easily got out of order, that surely something better can be devised. I speak from experience as to these, for I have tried to adjust them. I think we ought to urge the use of gas in our business in every way we possibly can. If we have arc lamps in the place let us try to push the incandescent gas lamp in every way we can to displace them. This gentleman has told us of the difficulty in introducing heating stoves for the consumption of gas. I believe in doing that most thoroughly. However, in cold countries, such as Nebraska, where the thermometer gets down to thirty degrees below zero, unless a man is a millionaire he cannot afford to use gas heating stoves. But the most important thing is to keep the gas range in the kitchen to do the cooking, for they can use the gas range economically for cooking all the year round, but they cannot use the water heater economically all the year round. So the question must arise of how most economically to heat water in the winter time. Some of our consumers will not take a water heater when for part of the year they must have a coal range to heat the water.

Of course, we do not believe in that, but we feel that we would rather have half a loaf than no loaf at all; and so we make connections with the furnaces in such a way as to give them all the hot water they require in the winter, and without any cost to them. We do it by taking the waste heat from the centre of the furnace. The radiation from the boiler will heat a small kitchen. If you want more heat there you can run the pipe from the furnace through a hot water radiator, and connect that with your boiler. In that way you not only have the heat, but you also have hot water. I believe to-day that we have ninety per cent. of our gas ranges in use in the winter; and we are going to have one hundred per cent. To my mind that is one of the most important things to a gas company. I do not know how many gas companies are doing it, for I have seen very little in the gas journals about it; in fact I have seen nothing except an occasional gas stove advertisement; and I do not know why they have not taken the matter up. This question of fuel gas is not the only thing we have to consider. We want to use gas all the time for all purposes; and we make a step in this direction in the way I have indicated. Of course, we make a charge for the furnace connection of ten dollars. I hope you will pardon me for speaking of local matters, because I am more identified with one gas works than I am with others. I am very certain that the suggestions which have been made have proven satisfactory and profitable to us. We try to get the owners of the property to put them in for the tenants; but where they will not do it, or do not like to do it, we endeavor to show the tenant conclusively that it will pay for itself in a very short time in saving the cost of coal by the use of gas fuel. While we sell a good many heating stoves, we cannot push them as we would like, because the question is often asked whether the use of gas is more economical than that of coal for heating purposes. We know positively that it is not. One of our consumers once told a gas man that he was the most honest and honorable man he knew, because he had told him the truth. So when I answer a question like that I always remember George Washington, and I tell them that they cannot heat their house as economically with gas as they can with coal.

The President:—We would like to hear from Mr. Spragle, of Johnstown, New York.

Mr. L. D. Spragle (Johnstown, N. Y.):—In selling gas for purposes other than lighting, each community seems to have its own individual interests to conserve with respect to the different uses of the fuel consumption of gas. Mr. Clabaugh has stated that owing to the cold weather in Nebraska it is impossible to use gas heaters in the winter time. This is, I think, largely true with most of us. I know it is the case at Johnstown, where it often gets very cold in winter; and because of that fact water heaters are almost uniformly discarded in the winter months. I have endeavored to use a connection with the furnace of the kind referred to, in a number of furnaces, but have found that with some designs of furnaces it is very difficult to get in, particularly steam furnaces with a double wall around the fire pot, that is with a water space between inner and outer linings. I would like to ask Mr. Clabaugh how he would make a connection in a case of this kind. Of course, there are ways of heating with gas economically, and there are heaters made which are not only economical in use of gas, but are, owing to their pleasing design and ornamental appearance, bought for the two-fold purpose of utility and ornamentation. We installed something over a hundred of these about two years ago, and the first six months showed a consumption of something over a quarter of a million feet. There are several points at which the customer may be attacked. In this case it was not alone the efficiency the customer was after, but the ornamental design when brought to his attention was something that he unconsciously was looking for and which would always be an ornament, while sometimes warming him.

Then again there is the field for power. I think that sometimes we labor under the delusion that not very much can be accomplished in selling gas for power. We thought so ourselves, but when we once got to seeking this business in a business-like manner, that is, understanding the thing we were trying to sell, and the needs of our customer, we found that there was a good deal of business that could be done by us in this line, which we have done and are now doing.

Mr. F. Egner (Norfolk, Va.):—It seems pretty clear that a paper like that read by Mr. Moses can give us matter for pretty lively discussion; and in it I would like to take some part and keep the ball a-rolling. Presumably Mr. Moses has not told us all that he knows about selling gas stoves, but he has said enough to start a very lively discussion. I must say, however, that I do not agree with him in all his statements. He says in his paper: "It is easier to build a gas works and produce one million feet of gas, than it is to find a market for the same; therefore, the most important end of the gas business relates to the sale of gas, rather than to its production." In that statement I differ with him. It depends upon how we look on that. I agree with him though in other matters. He tells us that "Many owners of gas properties have refused to invest the funds required for modern betterments and extensions." I have often found that to be the case. There seems to be a great deal of injudicious economy with some directors of gas companies, and with directing officers. For instance, they will not put in services free. And they will not set a meter free. Why? We still have that class to deal with at times in spite of all that has been said. I have figured up the matter and find, for example, that a mile of six-inch main would cost about $3,400, and perhaps a little more. For that expenditure 166 services and consumers' meters could be put in at a cost of perhaps $20 each. This they will not do. But just see if it would not pay. One of the writers of our papers states that the average sales per meter at some place which he mentioned was 32,684 feet. I think that is rather high. But if you will multiply the meters that could be set for the cost, and instead of that mile of main, by the average sale of gas, I think the result would convince anybody that it would be more economical often to put in the services free, and set the meters, than it is sometimes to lay mains. The figures struck me so forcibly that I thought I would bring them before you. You may take them along with you, and they may set some of you to thinking. I hope this will not be the last of the discussion on this subject.

Mr. W. S. Allen (New Bedford, Mass.):—I think the first step necessary with regard to using gas stoves all winter is to persuade the architects and builders to provide some means for heating the kitchens. That seems to be the proposition which almost every householder will lay down; "We cannot use gas stoves in the winter because we cannot heat our kitchens." It seems to me that the expense of doing that, when the gas is used properly, is so very small that if gas companies would take up that proposition and keep in touch with the builders and architects, and see to it that in erecting apartment houses some provision is made for heating the kitchens, we could get a great deal more gas consumption in winter than we do at the present time from the gas range. I may be permitted to say a few words about the way that some European companies have forced the consumption of gas among the poorer classes. Take for instance such a company as that managed by Mr. Livesey, which supplies the poorest districts in the city of London. He puts in a gas range, and a certain amount of gas pipe with burner in a kitchen, and puts in a penny-in-the-slot meter. The meter is adjusted to such a price as will give a return equal to a fair rate of interest on the amount of money invested, plus the depreciation of the apparatus. In that form of selling gas he has increased the number of meters in South London in an enormous ratio. I have forgotten the exact figures, but I think he has nearly one-half of his total number of meters out as penny-in-the-slot meters and under those conditions. It did not seem to be of any use to undertake to force the consumption of gas in the poorest districts of London; yet it was done by that company, and done successfully. In Paris, in cases where the rental of an apartment is less than $100.00 per year the company furnishes the connections free; if an apartment rents for a greater sum than $100.00 per year the consumer must pay the cost of setting the meter and of putting in the appliances. The result of that has been that the gas consumption in Paris has been increased very largely among the class of people who, under ordinary circumstances, would have used no gas at all. We are inclined to ignore these people. And yet, when the actual figures are made up as to the consumption in South London—and there is no poorer community to be found anywhere—the amount of gas per meter is almost nine hundred feet of gas per month, and if the price is fixed at such a figure as to pay the interest on the investment and cover the depreciation of the appliances, it will certainly give a very good return to any company.

Mr. Walton Forstall (Philadelphia):—I think it is to be considered in connection with the putting out of pre-payment meters that in some cities at least, the company would not be allowed to charge more for the gas supplied through a pre-payment meter than for that which passes through the ordinary meter. In London, Parliament has recognized that it is just that the company should make this extra charge. I think that Mr. Livesey's company was charging eighteen cents more per thousand, and Parliament made the charge uniform at twenty cents, and thus these companies are allowed by law to charge more for gas used in pre-payment meters. There is another thing which I think of importance. If we expect to teach our poor people to use the pre-payment meter, we will want a meter which will take a less coin than twenty-five cents at a time.

Mr. W. S. Allen (New Bedford, Mass.):—I think Mr. Forstall has touched exactly the point which the Association ought to take up and consider individually and collectively, and that is, such a modification of the statutes, if the control is vested in the State, or authorizing such action by cities, if the matter is controlled by the cities, that companies shall have authority to charge a sufficient increase on gas which is furnished through the penny-in-the-slot meter, to allow just the sort of work I have referred to; and in this I do not think there would be any difficulty whatsoever. Of course, I am more familiar with affairs in Massachusetts than in any other place, and I do not think that there would be any difficulty in convincing the Legislature, or the Gas Commissioners, that such a charge in addition for this additional facility is a perfectly legitimate and proper one. I think we certainly ought to have a meter which takes less than a quarter of a dollar at a time; and that our meter makers should supply a meter which will take ten cents, or even a nickel.

Mr. H. L. Rice (Norfolk, Va.):—There is one branch of the fuel business which has not been mentioned here at any length, and that is the heating of churches. In Norfolk, where we have a comparatively mild climate, we find that there is a very considerable business to be done in church heating. We are to-day putting gas radiators into every new church that is built, and almost every church which is making changes in its heating outfit. We put into these churches the best sort of gas radiators that we can obtain. We find that any church in a climate like that of Norfolk (which is only moderately cold in winter) can be heated more cheaply by the use of gas than by any other means. In fact, we get nothing but the most unanimous testimony from the churches which have been brought to use gas; they are entirely satisfied in that regard.

In Portsmouth, across the river, they began to push fuel gas somewhat earlier than did the gas company in Norfolk; and I believe that there every church in town is at present heated by gas. I will only indicate what will occur to all of you, namely, the advantage of pushing a Sunday business, so as to get the Sunday send-out on a par with the week day send-out. Since this church business has been taken over, our Sunday output has gone ahead by leaps and bounds.

Mr C. D. Robison (Geneva, N. Y.):—For heating a kitchen boiler I think there is no reason why a wrought iron pipe loop, cannot be cast in an ordinary steam radiator loop, and that connected with the kitchen tank so as to give an abundant supply of hot water, with no expense at all for fuel. If this were brought to the attention of manufacturers of steam radiators I think they would be glad to manufacture such a radiator loop which could be put on any radiator.

Mr. R. M. Searle (Mount Vernon, N. Y.):—I cannot let this thing go by. We are all in business for the profit; and there is no one here who would not get additional business if he could, and no one who could not get more if he would try for it. In a discussion last Spring in a meeting which I attended, I was asked what use it was to put out canvassers in trying to get new business. Of course, there is no use in it unless you have the right kind of canvassers. Suppose you are engaged in the business of pushing the Welsbach lamp against the incandescent electric light; you send out canvassers; of course the canvasser does not just walk into a house and simply say, "Good Morning. I have a Welsbach light. It costs $1.50. Do you want it? Good morning." On the contrary he must have some tangible reason to present for introducing the Welsbach. I would like to hear some one describe how he approaches different customers, and just what other companies do to get different customers. I would like to know just how Mr. Rice got the people in Norfolk to heat their churches with gas; and I would like to know just how another man got people to use gas for heating water in the kitchen boiler. A good way to make dividends is to save money in all directions.

But, to go back to where Mr. Moses speaks of the gas office. The average gas office has a little hole in the wall where bills are to be paid. Now, all those fences and bars between office employees and the public should be removed. Suppose a woman comes into the office determined to ask for an extension of time on her gas bill until her husband is paid, so that she can get a gas range in the meantime. She does not want to talk to the manager or clerk through a little bit of a hole, and make a grand stand play before all the people in the office, but would like to lean over the counter and talk confidentially with the clerk, explaining the difficulty, and ask for an extension of the gas bill for two or three days in order that she may pay the first installment for a gas range. Another thing which costs us money, and keeps away business, is the treatment the customers get, and the enemies the officers and employees of some companies make. Enemies are made every day, and in many ways.

I would like the President to get more than one to describe to us just how they go out to find customers, so that we may learn if there is any new method of attacking and obtaining consumers.

The President:—You have been reasonably successful—why not undertake that yourself?

Mr. T. Littlehales (Syracuse, N. Y.):—I would suggest that Mr. Searles give us a lesson in his way of doing.

Mr. R. M. Searle (Mount Vernon, N. Y.):—In his paper Mr. Moses speaks of salesmen, but not of canvassers. I am more and more of the opinion that the canvasser is a most important part of the institution; and to-day if we have canvassers of sufficiently high calibre to approach prospective consumers we may be sure of success with them. Mr. Clabaugh says that he cannot sell gas radiators for use during the winter. He further complains that he cannot interest the millionaires in the use of gas. If we have millionaires we want canvassers who can get audience with them. They are hard to approach, their time is taken up, and it requires a genius to get an audience with them. We want canvassers with sufficient tact to tell the lady in her kitchen that her hand is too white to soil it by handling a coal stove or to have it soiled with the ashes; and that a gas stove will remove that difficulty, if he can only show it to her. One canvasser may have the tact to approach her in that way, where two other men would get licked in the attempt. Then again, in introducing the Welsbach against the incandescent electric light, if the man runs across a jewelry store where a fine display of jewelry is made, he will walk in and say to the jeweler that he would like to show him how he can make a sale of ten per cent. more diamonds by the use of the Welsbach light, than he can with the electric light, because the diamonds will show to better advantage. If properly approached the jeweler will listen to the canvasser under such circumstances, with the result that a Welsbach will be introduced. Or, take another illustration. Go back to the millionaire. I know one instance where a millionaire complained that his gas bill was $42.50 for a range per month. I asked for his bill. He said, "I have not received my bill, but the meter taker told me it would be that." I saw the trouble and immediately replied, "Your credit is good, and we don't have to send you any bill." He said, "Oh, yes, but I always pay my bill regularly, and would not be without that gas range for any money." Now, if a canvasser has the understanding and tact to take things as they are, and to think quickly, he is worth money. The trade is good—the high class trade—but to get it you want a man of high calibre. He needs all his tact in approaching a millionaire. We have in our district men who come to New York in yachts at a cost of $50.00 or $100.00 a trip, when it would only cost them fifty cents to come by train. The money is no object to them at all. What they want, and what they are willing to pay for is comfort. If we have a canvasser who can approach such a man, and suggest to him that he wants his morning rest, and does not want to be disturbed by the butler when he shakes up the furnace; and that he can fix him up with a gas radiator which will give the heat, and dispense with the furnace and the noise, he will be very apt to get the order.

Mr. F. R. Persons (Toledo, Ohio):—I have not had very much to do with canvassers, but I have had a little bit of experience. We keep one class of canvassers whom we call the back door men. Such a man goes to the back door and finds the women at their work. Another class and a better educated class, go to the front door, and reach the lady of the house. But above all among the canvassers we have had we have none who ever tell anything except the truth. They never make mis-statements. If we guarantee a range, or a light, we are bound to stand by that guarantee; and if they make a mis-statement, they are bound to make it good.

Mr. H. H. Ganser (Norristown, Pa.):—I believe that a canvasser can be very useful to the gas company in getting customers if he has the tact to go about it in the right way. If he can go to a house, ring the door bell, get the woman to the door, and make a few casual remarks, at the same time being very careful so that there can be at first no hint of what he is aiming at, and so that the woman may not think he is a picture frame agent, or something of that kind, and then let her know he is selling gas ranges, he will likely be on the right track. Now, when you get a range into that house, don't say, "Here is the bill—$10.00" and get the money, and consider the matter ended; but you must see that she knows how to use the range. You must drop around, get into the kitchen, sympathize with her, agree with her in everything she says, encourage her to go on and tell you everything, and then watch how she bakes, because I find that this is how large bills are usually made. You will very likely find that she has turned on both burners, or will allow them to burn too long, so as to do the baking too quickly with the result of not getting as good bread as she would do if she had a smaller fire. Or, he may go into a barber shop and say, "I see that you are burning coal-oil. What does it cost you?" He replies, "It costs me sixty-five cents a month." This man has been burning coal-oil for the last ten years and will burn it for ten years more unless shown otherwise. You may think that there could be very little gas sold in that shop. But it is just this way; a customer comes along, sees that the shop is changed, and that the man is burning gas instead of coal oil. The customer infers that the man's business must be growing. Another customer drops in, and then another. They see that the man is keeping open until ten o'clock. He used to close at nine o'clock. They go by there on a Saturday night and they find that the shop is open at twelve o'clock. His gas bill is a great deal more than his coal oil bill used to be, but he does not complain, for the reason that he is getting more trade. You may feel that in getting in a gas light, or in introducing an improved burner, you are not only doing yourself a favor, but you are also doing the person a favor.

Another thing I have never heard mentioned is the use of gas by the Italian peanut vender. He is accustomed to use a gasolene burner. In the town where I live there are a great many Italian peanut roasters; and in the last three months three of the roasters have changed from gasolene to gas. In one instance I told the Italian vender if he would burn gas one month I would not charge him for it. I got some one to spot him to see how much gasolene he used. and I ascertained that he bought ten gallons of gasolene every Saturday.

That is what I mean when I say a canvasser is a most important factor in a gas company. But do not let the canvasser go out and do all the hustling, go out and hustle for yourselves.

Mr. R. M. Searle (Mount Vernon, N. Y.):—Another thing that the canvasser should be trained to do, which has not been referred to by anyone yet, is to have canvassers who can calculate the power required when bidding on a gas engine. For instance, a canvasser goes in and asks how much power a consumer is using. If he is a man of tact he will not ask that question, because he will be able to ascertain that from his own observation. The canvasser must be so skilled that he can either write to the manufacturer of any machinery, or make the calculation from the belting and pulleys, or ascertain the displacement of pump plungers and pressure required, or in any other way which enables him to ascertain the power which a man is using on an engine or pump, or other machinery that he wants to find out about. He can get generally every boss machinist, and every manufacturer of a machine, to calculate the horse power that that machine requires; or he can find out from the ordinary catalogues which may be had for the asking. He can find very accurately the horse power from the shafting or belting; and having ascertained that he is able to bid intelligently. I have failed to find canvassers who could figure out for a man how much horse power they would require. If you have a canvasser soliciting for a gas engine, you will be apt to find that the reason he does not get an order is that he does not know the horse power that the person requires, and of course, cannot bid intelligently on the engine. In other words, he does not know what he is talking about.

Mr. A. S. Miller (New York City):—Before the discussion closes I want to register a protest against the statement made by Mr. Moses in his paper that, "Fuel gas is recognized as a redeemer of the gas industry." Attention has been called to this point already in this discussion, but I want to say that I think a larger part of our business is still the lighting business, and that the larger part of it will continue to be the lighting business if we put into the lighting end anything like as much energy and time as we put into the fuel end of the business. We get up here in our meetings and talk much of fuel gas; the members go out and work for fuel gas; we go around the town and we see large and attractive places lighted by electricity, the lighting of which we know the gas company could get if they would start out and work to get them. They spend a whole lot of money to convert a peanut roaster or something else, when if the same money were put into intelligent work on large consumers they could win converts from those who use the electric light, and induce them to become gas consumers. As a matter of fact the papers which have been read before the electric light associations of the country show that incandescent gas lighting has made very serious inroads into incandescent electric lighting; and I believe that these inroads would be very much more serious than they are if the lighting business were pushed as it should be.

Mr. G. W. Clabaugh (Omaha, Neb.):—There has been a great deal said about canvassers, but I think that if a gas company has five thousand consumers, that ought to mean five thousand canvassers; and they would not cost the company anything. If you treat your customers properly, and show them all the courtesy you possibly can, no matter what the complaints may be—it may be very trivial to you, but it means a great deal to them—you may in that way make every consumer a canvasser. Business men generally have the erroneous idea that if they have a hundred consumers, and they lose one through mismanagement, or for whatever reason it may be, they are still just as well off, for they can get another consumer in his place. But I do not think so. I would rather have that one old consumer, than have a new one in his place. If I lose one, I have hard work to get him back. If you treat your customers properly, they will sell stoves for you. A well satisfied consumer, and particularly if it be a woman who will talk—and most ladies do talk—will always canvas for you. Keep your canvassers out, keep your men going all the time—I thoroughly believe in that—but at the same time I believe in making one's customers do the canvassing.

Mr. E. E. Witherby (New York City):—We have almost all made our statements here solely with reference to the local conditions that govern ourown work. I have one particular case wherein our electric light plant was in almost an overloaded state, so that it was probable that our holiday lighting would put us in such a position that it would either fall down at a critical time, or else we would not be able to supply the customers. I do not want to advertise the wares or goods of anybody, but I want to say that at a meeting in Louisville there were a couple of lamps put on exhibition that I thought would just about fill the bill. We could take those lamps and use them as arc lamps. In less than sixty days we put in over eighty of those lamps. We pursue the same policy as in the electrical department, removed the electric arc lights, put the gas arcs in, and maintained them, excepting mantles. If we found a mantle had broken we put in a new one, and charged fifty cents for it. There has not been any kick yet at the mantles we have been using; and it relieved us of the necessity of installing a $40,000 plant this summer. We have found the result to be a most satisfactory increase in our illumination with gas.

Mr. J. T. Lynn (Detroit, Mich.):—I want to protest a little as to Mr. Miller's remarks with regard to fuel gas not being the salvation of the gas company. I do not believe that outside of the large cities there is one gas company in ten whose fuel account does not run larger than the illuminating account. While I do not want to take away any of the credit due to those who are pushing the business of illuminating gas, at the same time I do not want to see their efforts relax in the direction of increasing the sales of fuel gas. I believe that to the fuel gas appliance men there is due a great deal of credit from the gas men for their energy and their efforts in putting gas appliances on the market, and thereby contributing to increase the consumption of our product.

Mr. F. Egner (Norfolk, Va.):—Mr. Searle asked a question when he first got up which surprised me very much. I was surprised that he asked it, because I thought that he knew all about it. He asked Mr. Rice about the introduction of gas in churches. I hope Mr. Rice will pardon me for anticipating his answer to Mr. Searle's question, but I was his predecessor in that business at Norfolk. One of the proprietors of that company was very anxious to introduce gas for heating purposes into the churches in Norfolk. We had taken some steps in that direction, and we found that the church people wanted radiators, and that they wanted them for nothing, if they possibly could get them in that way. At any rate they wanted some concessions. I wrote to my President about these gentlemen, and what they wanted, but all the concession that he was willing to make was to put the radiators in as cheaply as possible, but that the gas company was not going to be out anything for them. The company was willing to do without any profit on them, but was not ready to give away anything. The request to introduce them into the churches at Norfolk was becoming very urgent for the reason that they had them in Portsmouth, just across the river, and they were very satisfactory there. I got them to use some gas stoves in two of the churches, and I did it in this way. As the gas company would not give them anything for nothing, and as the proprietors were very urgent that we should have them, I bought three or four radiators myself and presented them to the churches. I do not want you to think I was acting the part of a philanthropist in doing this; not at all; I was only very anxious to retain my own position. And so, in order to introduce the thing, and get a start in the churches, I bought the radiators and gave them to them. I suppose that was the starting point of the prosperity of the Norfolk Gas Company resulting from the putting of gas stoves in the churches. I would like to hear from Mr. Rice about that.

Mr. H. L. Rice (Norfolk, Va.):—Mr. Miller has spoken about the fact that we are still in the illuminating business. I agree with him thoroughly as to that. We find in our town, although we are associated with the electric lighting company, and therefore do not solicit for illuminating purposes to any great extent, that the illuminating account is still growing very rapidly, almost as fast indeed as the fuel.

Not a word has been said here in this discussion on the subject of piping old houses, which I think is a very important matter. I would like very much to hear from some men who have had experience in getting old houses which are not piped to take gas. I mean houses which are on the line of the present mains. We all know that if you take any gas company and go through its records and maps you will find on its lines of main a good percentage of houses which are not burning illuminating gas, and which are not piped. If you send a man to them to ask them to burn gas they will reply "The house is not piped, and it will cost too much to pipe it." Perhaps they may say that they do not want the house torn all to pieces. Now this is a business that must be looked for and gotten. We do not let the lack of pipes stand in the way of getting fuel business. In our town we have an open mind as to the best means of getting this illuminating business. We are trying to get the best scheme we can, for we believe in pushing the illuminating account as well as the fuel. These people in unpiped houses are not the ones that the electric companies are after. They are people who would take gas in preference to using kerosene if they could only be shown and convinced that they can avail themselves of it without too great an outlay or too much trouble.

Mr. G. W. Clabaugh (Omaha, Neb.):—I would answer that by saying that we have run pipes to a very large number of houses, and have sold to a large number of consumers; and in doing that we do not come in conflict with the plumbers in any way; we do not do it at cost; we make a slight profit on it. In the gas business we do lots of things for nothing, and it is all right; but we do not do everything for nothing. If you try to give away everything you have got, it will not be long before the Legislature will come to you and say: "If you can give so much away why do you not reduce the price of gas for the benefit of the many, instead of the few to whom you are giving these things?" That is what I want to anticipate. You can pipe these houses without any trouble by proper solicitation. Go after them, and offer to do the work cheaply—and you can do it cheaply—and you may make a profit on it.

Mr. G. H. Harper (Altoona, Pa.):—Following up Mr. Clabaugh's remarks, and also those of Mr. Rice, I will state that in the town which I represent we have just completed a canvass of the entire city—not going beyond the line of existing mains; and, by the use of the card system of indexing, we have at hand and in convenient form, information as to every house on the line of our mains, whether it is piped or otherwise; if piped, whether they are using gas; if they use gas, for what purpose, whether for light or fuel; what fuel appliances are used; whether hot plates, ranges, or otherwise; and whether the ranges are satisfactory; the number of rooms in the house; whether the occupant owns or rents. So that when we go to these people at any time in order to solicit them to use gas we know positively just what their requirements are, and what are our chances of success. I know positively that were the company in a position to take full advantage of the information obtained we could increase our business twenty-five per cent.

Mr. F. H. Shelton (Philadelphia):—I know of one company which, by an expenditure of five per cent. of its capital account has increased its business nearly one hundred per cent. within less than six months.

The President:—It is not the disposition of the chair to curtail this discussion, for it is very interesting; but we have a great deal before us, and unless some member has something more to say I will call upon Mr. Moses to close his discussion.

Mr. F. D. Moses (Trenton, N. J.):—I have made a few notes of the suggestions made by members in the discussion. A few days ago a man came into our office and remarked that he came from the West; and that he heated his house from Washington's Birthday to Thanksgiving Day with gas at $1.00 a thousand. He found that it was the most economical way of heating it. But from Thanksgiving Day to Washington's Birthday the weather was so cold that it was necessary to use a furnace. We are trying now to sell small coke stoves for three or four dollars, to be put in the kitchen, to warm the kitchen during the winter months, and to use our coke. A kitchen does not require the same degree of heat that any other room in a dwelling house does, because there you are moving around nearly all the time and therefore do not require the same heat that you do in a sitting room. A great deal of our out-put at present is used by the working people, who get up late in the morning, and have to use the gas stove in order to get breakfast in a hurry. We usually run a hundred feet of main for each new consumer secured on a street, and the average gas bills have increased from $1.70 to $2.26 per month, by the meter,—showing that they are all using more gas. We have something like seven or eight solicitors out all the time. We do not send them over the same territory twice, only where they have some prospect of selling. We always keep the best man until the last—and the last is a lady. She goes after them, and she either gets them as customers, or talks them to death. We also have a professional baker—not a cook—but a regular baker, and he goes around and teaches the families how to bake with a gas stove. Those people do not care much about learning to make lobster Newburg, but they want to know how to bake bread and biscuits; and this man teaches them how to do it; and if they will let him, he will make up a batch of bread while there.

A Member:—I move a vote of thanks to Mr. Moses for his paper. I think that he has given us a great deal of information which will be useful to all those who are in the gas business. We have known that he has accomplished very great results, and in a very original way; and what he has accomplished will encourage members in other places to try to do the same thing. It has stimulated them to put forth great energy.

The motion was seconded and carried.

The President:—While upon this subject, and inasmuch as

Mr. Moses, who represents this Association on the Committee on Advertising, is obliged to leave the city to-night, to give him an opportunity to report for his Committee, I will call upon him now to read the report. A year ago a Committee was appointed by this Association to make a report before this meeting upon some scheme of advertising—some scheme of co-operative advertising, or national advertising, or along such lines. The Ohio Association has appointed a Committee, as also has the Western Association. Both of those Committees have made their report; and we will now hear the report from Mr. Moses.

Mr. F. D. Moses (Trenton, N. J):—In obedience to the request of your commission, your Committee has looked into the matter of National Gas Advertising, and have to report to you as follows:

In order to carry out the matter of national advertising of gas, a fund would have to be created. This money could be obtained by small assessments on the gas companies determined by the benefit they would receive. According to figures given in the gas directory, there are 32,000,000 people in this country, either supplied by gas, or who could be reached by gas companies. If every company would be willing to subscribe $1.50 per year for every one thousand of the population it could supply, it would give $48,000 for general advertising; supposing that only companies representing one-third of this population should subscribe to the fund, $16,000 would be subscribed. This money would be used for magazine and bill board advertisements, and for the maintenance of a bureau for distribution of advertising matter. Monthly magazine advertisements have been used to much advantage to popularize different commodities, and ten of the leading publishers in the country have been asked to furnish figures for advertising in their periodicals, and their figures show that the cost per page per month is from $250 to $4,000, which price is governed mostly by the circulation. For about $2,000 per month we could have a quarter page advertisement in all the leading magazines, and six months advertising, which we would probably use per year, would cost $12,000. With a fair proportion of the companies subscribing we could place the word "Gas" before the public as often as they now see the names of different kinds of soap, pills and biscuits; and the cost to gas companies would hardly be noticeable. Take for instance a gas company in a town of forty thousand inhabitants, their assessment would be only sixty dollars per year, or five dollars per month, and even the smallest possible results would fully reimburse them for their subscription.

Your Committee would also suggest that a Bureau be established that would be a "clearing house" of gas advertising matter, where all companies could send any advertising matter or designs that would be of interest to the others; this matter could be put in pamphlet form together with ideas by gas managers, and any other matters of interest to the subject. These pamphlets would be furnished free to subscribers, and those companies not subscribing could get them at a price determined by the cost of compiling them. Your Committee requests the right to work with the Committees of the other Gas Associations, and to be also empowered to solicit subscriptions to the fund, and commence work as soon as possible. The matter has been under discussion for several years, and as we have only met once a year progress has been slow, but if the start is made now the results of one year's work will be so surprising that all gas companies in the country will gladly contribute to the fund.

In connection with that I would state that the several advertising agencies that we have talked with want from five to ten per cent. of the cost of the advertising matter to place the advertisements of the Committee. I can see no use of this cost, and I do not think that anybody can write an advertisement as to gas better than a gas man can do it.

I have a letter from Mr. Doherty, a member of the Committee who cannot get to this meeting, which Mr. Persons will read, if you desire.

Mr. F. R. Persons (Toledo, Ohio):—I have read the letter over since I have been here and think it very interesting. Mr. Doherty says:

"My faith in the results of national advertising have never wavered for a moment. If I had the time I would be glad to show my confidence in our ability to raise the fund required; but conditions have so changed with me that I have become incompetent to do any of the work. I would resign from the Committee did I not believe that I would be free to take up the work again in the near future."

He proposes to take up the work of national advertising by and by. Mr. Doherty is the President of the Ohio Association and is on the Committee of the Western Association on this subject. We have a Committee in the Ohio Association similar to this in the National.

Mr. Wm. H. White (New York City):—I move that this report be received, and the request of the Committee, that it be empowered to associate itself with the Committees of other Associations, to go forward with the work with the consent and endorsement of this Association be granted.

Mr. T. Littlehales (Syracuse, N. Y.):—I second that motion.

Mr. F. H. Shelton (Philadelphia):—Before that question is put I would like to ask for a little more information on this subject. As I understand that report, it contemplates that the Committee be empowered to at once commence upon their work by asking subscriptions from the various gas companies. I do not understand that any general or joint final action has been determined upon. I do not understand who is going to be responsible for determining just what advertising will be done. I may not have gotten the full force of this report, but my impression is that it mostly centers upon magazine advertising. This kind of advertising reaches every gas company in the country, and it reaches the customers of every gas company in the country. If only one-third of the gas companies of the country subscribe to this advertising fund, the other two-thirds will get the benefit of the money of the one-third. Are there other lines of advertising that the Committee contemplate? Will they advertise by means of bill boards, posters, and other local advertising? I would, of course, assume that other lines of advertising would be put out only in the cities of those who have subscribed to the fund. Those who have not subscribed could hardly expect to have any bill posting done. It seems to me reasonable that before acting as an Association on this matter we should understand more clearly what it is contemplated by the Committee shall be done, and determine for ourselves the advisability of joining in the work. As now presented it seems to me to be rather nebulous; and I do not think that the Association should as yet go on record as advocating this matter. Let us understand what it is proposed that we shall endorse before we stand for it. I for one would like to have more accurate information as to what is proposed and contemplated. I do not want to be considered as obstructive, because I thoroughly believe in advertising, and in publicity, all along the line. The greatest success I have had in building up gas companies quickly has been achieved through advertising and from publicity. But I must confess (and I think I am one of many) that I do not clearly understand exactly what is contemplated, except in very general lines. I think that before subscriptions are asked for, and before this Association, or its Committee, goes on record as endorsing the proposition, we ought to have some more knowledge of what the proposition really is. I think the better plan is for the Committee to simply report progress, so that the Council of this Association may later have an opportunity to determine whether it will endorse the project or not.

Mr. F. R. Persons (Toledo, Ohio):—The general idea that the Committee proposes is, with their own funds, to send out to every American gas company, all over the United States, reasons why they should subscribe to this fund. This will be sent by card. These cards will be sent out once a week, or once in two weeks by the Committee. This would not be very expensive. They propose to mail these cards by November 1st, and then by January 1st they will send out a request for subscriptions to the fund; and they will start the advertising by March 1st, if the request for funds meets with a sufficient response. The Committee has taken that matter into their own hands, and will incur all the preliminary expense. When a part of the money has been subscribed, or guarantees offered, they will start in. They will then bring the matter to the notice of the gas companies individually—not through any one Association but through all the Associations, by sending communications to every gas company, and asking for their opinion of the project, and for a statement of how much they are willing to pay, and what they want done. We have an idea that this Committee will provide sensible and seasonable matter, by postal card or otherwise, to every gas company subscribing to the fund; and if any gas company which had subscribed wanted a cut for its local paper, they would be provided with it; thus making a sort of transfer bureau of it.

Mr. F. D. Moses (Trenton, N. J.):—I would state that it has been very hard to get the Committee together, or to get their views embraced in one general report. This matter of bill-board advertising was discussed between us; and such things would be made in large quantities, and would be furnished at cost to those who subscribed to the fund. Those who did not subscribe, but who wanted to use them, would have to pay an advanced price for them; and this would cause them to subscribe. I do not think the Committee would want to do anything without the approval of the Council. If the Committee is told to go ahead, and get the facts and figures, and then report to the Council for further instructions, they will do so. But I do not think the Committee wants to take the responsibility of collecting the money and of paying it out without further instructions. Let each Committee report to the Council of its respective Association, and gets its orders before going further in the matter.

Mr. Wm. H. White (New York City):—In making my motion, I had a clear conviction that these several Committees of the Association would meet together, or have met together, and formulated some general plan; and that each of the other Committees had already had the endorsement or authorization of the Association which that Committee represented; and that this Committee of ours was only asking for authority to go on with the work in conjunction with the other Committees, and upon the lines which they might agree upon in the future. When it came to collecting money, and disbursing it, our Committee would naturally report to our Council what they proposed to do. It would be absurd for us now to ask the Committee to again consider this question, and wait for our action for another year before they could do anything in the work. We should thus lose the benefit of an entire year's advertisements and for an entire year do no work in this important field. I think it is proper that Mr. Shelton would desire to be advised as to what this Committee proposes to do; and I am glad, he asked the question. I had assumed that the lines expressed by Mr. Moses and Mr. Persons were about what they intended to do; and my motion asked the Association to endorse what they had done so far, and to authorize the Committee to go on and do the work on the lines suggested, but not to assume any financial responsibility in the matter until the consent of our Council was obtained. With that explanation my motion will stand.

The motion of Mr. White was seconded and carried.

The President:—We will now proceed to the next paper which is that written by William E. McKay, entitled "Tar and Water from Water Gas."

(For Paper see Appendix page xxi.)

The President:—Having read the paper, Captain McKay now desires to explain what he has in these bottles.

Mr. Wm. E. McKay (Dorchester, Mass.):—The bottles in this case contain samples of tar emulsion in its various stages of separation, and also the lighter fractions of the distillation of tar. This first sample A is of stored separated tar, ready for sale. In our tar of this character the color of the reflecting surface is distinctly brown. As the tar is distilled, and progresses towards pitch it loses that brown color. You can tell the proper time for stopping the distillation of the tar if you are sufficiently familiar with the color. The light of this room is not good for distinguishing the colors, brown, red, green, yellow and white, of these fractions B to M, but they show in a general way all the gradations of color and density which occur as the lighter fractions are taken off. This particular distillation was not carried quite far enough to yield a perfectly pure white fraction. These samples N, O and P, are the fractions which correspond with the first distillate from coal-tar,—otherwise, the ammonia and water. You can see their colors in this case is a very deep blue from the cyanides; the color varies with the amount of cyanide present. In this other case of bottles an examination of these samples will show the watery emulsions, and the partial separation which has taken place since the bottles were brought in here ten hours ago. All these five samples, AB to AF, are with varying amounts of water in the unseparated tar. Here are three samples, Q, R, and S, of the water which is the final overflow. Q is a sample of the water entering the filter-box where the last tar is taken out; on the glass bottle, above the water, can be seen a thin scum of oily lampblack, which is carried along with the water as it runs into the filter-box. Before this sample was shaken up by being brought in here, the lampblack and tar could be seen in little globules at the centre of the surface of the water, but they are now deposited on the dry glass surface of the bottle. At the bottom of the bottle Q you can see the fine lampblack, which is the cause of the trouble in the separation of the tar. These other two samples, R and S, are of the water as it leaves the filter-box; and I think you can see that there is no tar whatever deposited on the dry surface of these bottles, although the color of the water is dark from the ash it carries, that cannot be separated from it. In the bottom of each of these samples, R and S, you can also see the lampblack which is carried along with the water. In this bottle T is a sample of the screened generator cleanings before being used; bottle U contains the screenings after use in the filter-box. V and W are shavings before and after use in purifying boxes for filtering tar. Here are four samples, X, Y, Z, and BS, of the material which causes the trouble with the tar. X is a bottle of naphthalene, lampblack and ash, showing the little particles which clog up the condenser tubes; in one case we took from a 20-inch main three tons of this material. Y is the separated, dried lampblack, which travels with the naphthalene. Z is the separated dried ash, which, together with the lampblack and naphthalene, causes much trouble. This sample is the familiar BS; the presence of this in the oil introduces a mineral substance into the apparatus that is afterwards partly taken out by the tar. Here is a sample of the pitch from water-gas tar, which has a fine lustre, a good fracture, and a good odor. You can tell that it is water-gas tar pitch; and yet it has a very satisfactory amount of lampblack mixed in with the bituminous compound made.

The President:—You have heard this very interesting paper, and it is now open for discussion. Has Mr. Miller anything to say upon this subject?

Mr. A. S. Miller (New York City):—It is hardly necessary for me to say that I read this paper with a great deal of interest, and that I appreciate all that Captain McKay has done for us in this direction. I have been very busy and did not have a chance to study the paper as I would like to have done. I have not been quite as familiar with the working of this class of apparatus recently as Mr. Morris has been; and if you will pardon me, I will get Mr. Morris to tell us what he has been doing, and to draw some comparison, if possible, between the two systems; because I do not feel that there is anything that I could add to what Captain McKay has said.

The President:—We shall be glad to hear from Mr. Morris.

Mr. W. C. Morris (Ravenswood, N. Y.):—I quite agree with Mr. Miller that it is quite impossible to add anything to Captain McKay's paper; but as I have used an almost directly opposite system from that of Captain McKay, there may be some points which may prove interesting. In our system we use three tanks 26½ feet in diameter and 8 feet deep. Across the middle of each tank there is a partition extending from the top to within 30 inches from the bottom. The fluid coming from the overflow of the wash-boxes and from the drains about the works passes into one of these tanks and overflows in series into the other two. A portion of this tar is pumped from the inlet of the first tank back to the wash-boxes, and so reduces to some extent the flow through the system. The temperature of the emulsion is kept at about 160 degrees as nearly as we can, using exhaust steam when from colder weather or other cause the temperature of the emulsion falls below that point. Our results, as to the quantity of tar that is obtained, are very close to those given by Captain McKay. We obtain about thirteen per cent. against his thirteen and a half per cent. for crude oil. I take the average figures. My figures are obtained from a year's run. With gas oil we obtain 14.6 as against his 15.6. There is one thing in Captain McKay's statement to which my attention has been drawn, and that is that he seems to take the emulsion flowing into his system and pass it into a series of wells, and then into a separator. I am not quite clear from the paper how large they are, and I would like as a matter of interest to ask him to tell us just what their object is. It seems to me they serve merely as a temporary reservoir from which to return the water to the wash-boxes, and that the portion not returned to the wash-boxes is turned over to the storage tank, or to the tank in which the steam coil is placed. In that tank he uses steam at 110 pounds pressure. If there is some reason for using steam at a high pressure I would like to know what it is. The tar we obtain is of about the same gravity as he has noted with the gas oil. He states in a later page that the cost of separation with the Wilkinson apparatus was two-thirds of a cent per gallon of tar. This, of course, includes the cost of steam. In my own case I have no record of the steam. The only steam we use being exhaust steam, we do not consider it as costing anything. The actual cost of the labor of separation of the tar by our system came to 0.03 cents per gallon on an average of three years. He also states that in his large tank, in which he uses a steam coil, after a necessary interval the steam is shut off. It would be interesting to know what length of time that interval is. One other point comes to my mind as to this emulsion, which I presume he returns to the wash-boxes from the tar-wells—I would like to know whether at any time he noticed high pressure from tar collecting in his wash-boxes, due to the foaming effect of the emulsion; and if so, whether he is able to rid himself of that uncomfortable situation. I have at times returned all the water coming from the tar system into the wash-boxes, and have succeeded for weeks at a time, without trouble. But as soon as the pressure would get up we would have to clean out the whole system and start up with fresh water, eventually returning this thick emulsion to the system again for separation. Further on Captain McKay states that "The maximum observed efficiency of this system was the separation, from its emulsion, of 3,500 gallons of clear tar per day." I would like to know whether or not, this was the maximum of several days, or whether he had gone several days without separation, and then obtained the 3,500 gallons. Several times at our works we have tried to check up on the condensers and other apparatus results which required the use of the specific heat of the vapors in the gas, but I confess we have never been able to check them. I would like to know what figure Captain McKay used for the specific heat of the vapors, and if possible, how it is obtained. A little further on he refers to the net efficiency of a gallon of oil. It would be interesting to know the time of year this net efficiency was obtained. I have figured upon it at our works, and the best figure was obtained during the month of July, 7.51 for the month. I would like to know whether the figure which Captain McKay gives corresponds to this time of year.

Mr. Rollin Norris (Philadelphia):—Captain McKay has gotten up a mass of information to which in this discussion it is impossible to do justice.

But there is one point I would like to bring out more fully. In looking over the references in the appended notes one cannot help but be struck by the variations in the statements made by different authorities as to the composition of water-gas tar. Of course, that is due to the fact that there is tar—and tar; and water-gas tar is not a fixed uniform product, but will vary very largely according to the way the oil is treated. Just before leaving home I picked up a bundle of water-gas tar analyses, without any reference to what story they told. On page xli of Mr. McKay's paper you will notice that Durand Woodman gives nine per cent. of lamp-black in clear oil tar; and that Dr. Schniewind gives twenty-five per cent. In these thirteen analyses before me six of them have less than one per cent. of free carbon. I do not think that Captain McKay gives the free carbon in his tar analyses.

Now, with regard to the pitch. Note Q, on that same page gives forty per cent., or a little over, as the residue of hard pitch after distillation. My analyses run 26.41%, 28.19%, 20%, etc., or about 22 or 23 % as an average.

In regard to the naphthalene, the same note Q shows 22.5 of naphthalene. I do not know whether our determinations were made in the same way. We do not in our tar analyses determine the amount of naphthalene actually present, but the amount of naphthalene which is separated when the fractions cool down, this being the excess beyond that required to saturate the fraction. With that explanation, the naphthalene in these samples varies from zero up to twenty-seven per cent.; but eight of them have no naphthalene in them at all; and most of them run from zero to not over three or four per cent.

I mention these figures as showing the difference between the constitution of the tar under different circumstances, and to emphasize the statement that we must be careful not to base our opinions of this product upon samples taken in only one case.

Mr. F. Egner (Norfolk, Va.):—I see Mr. Thomas Curley, of Wilmington, Delaware, in the room; and I have a distinct recollection of seeing him experiment on that subject; and if he could be persuaded to give us his experience I am sure it would be valuable to us.

Mr. Thos. Curley (Wilmington, Del.):—I do not know that I can add anything to what has been already said, as we have not experimented with regard to the naphthalene contained in the water gas tar. The tar from our water gas apparatus appears as nice and as good as that from the coal gas plant. Neither are we troubled with naphthalene about the works. We mix both coal and water gas tar and sell the mixture to the tar distillers, and they consider it first class.

Mr. Rollin Norris (Philadelphia):—May I add one word? I would say that at one of the large works in this country, covering a period of several years, the amount of water-gas tar made was ten per cent. of the amount of gas oil used, the tar being calculated free from water.

J. B. Klumpp (Omaha, Neb.):—An analysis of our tax shows about fifteen per cent. of solid naphthalene, and agrees with Mr. Norris' statement of about 40 per cent. pitch. The gas is treated to dry scrubbing and condensed through tubular condensers. As to the percentage of free carbon, I cannot say positively but think it about ten per cent.

Mr. A. E. Forstall (New York City):—At the bottom of page xxvi in checking up the agreement between the observed deposition of tar and water and the computed deposition of condensed aqueous vapor as given in Table IX, Captain McKay says, that "at the wash-box, with gas at 192 degrees, saturated with vapor, the table indicates that each 1,000 cubic feet of holder gas will take from the wash-box 91 pounds (nearly 11 gallons) of water and tar."' That statement is apparently based upon the assumption that the gas coming from the apparatus is dry gas. On page xxiv, it is stated that "the onward flow is only equal to the tar made, plus the excess of steam used in the Lowe apparatus." It seems to me that the check between theory and practice is faulty by the amount of undecomposed steam coming from the Lowe apparatus. I believe that there is a fairly large amount of excess of steam in gas coming from the Lowe apparatus. I also fail to see exactly the logic by which one gallon of tar is considered to be equal to one gallon of oil in figuring the net efficiency of oil. It would seem that the tar and oil, being of different weights, it must take more than one gallon of oil to produce a gallon of tar; and that when producing one gallon of tar per thousand cubic feet of gas, using five gallons of oil, the net efficiency of the oil must be higher than is here figured.

Mr. Carroll Miller (Chicago):—I would like to ask Captain McKay just how it is that the addition of oil tar to coal tar improves the quality of the coal tar; because oil tar sells for a good deal less than coal tar; and there must be some reason for it.

The President:—If there are no further remarks Captain McKay will close the discussion.

Mr. Wm. E. McKay (Dorchester, Mass.):—Mr. Morris, in speaking of the wells used in our system, said that they appeared to be temporary storage tanks. In a certain degree that is true. Our wells were designed originally before we had satisfactorily reached a good practice in handling the tar; and we had to provide for the heavy flow of water, and anticipate the tar, in the different sections of the well, allowing the water to go overboard. Afterwards, when we were able successfully to use the regurgitating system, some of the wells became idle, so that in a certain measure they are storage wells. He also spoke of the cost of separating and referred to the figures which I gave for the Wilkinson tar. We received that tar from an outside source, and were asked to separate it, and that is what it cost us to handle it, separate it, and re-ship it,—two-thirds of a cent per gallon of clear tar. In our own case, with less cost for labor, it would be ⅛ to ¼ of a cent per gallon of clear tar. If it can be separated by exhaust steam, I think that a great advantage. We had one hundred and ten pounds steam pressure upon the coil, in a closed tank; and a break in the coil would introduce a very large volume of steam into the tank, causing a pressure for which the tank was not designed. So we have to provide safety vents and safety seals. If exhaust steam can be used, if the heating surface and the temperature available will separate the emulsion of the tar and water, I think the lower the steam pressure the better. In our own case, when we use 60 pounds steam pressure it costs us more than twice as much in fuel to separate the tar as it does when we get a higher pressure. In other words, the higher the pressure the higher the temperature and the greater the economy. As to the interval of steaming,—if observations are made during the rise in temperature in the tar emulsion it will be found that the first difficulty comes in driving off the absorbed gas,—as in coal tar. When that is all off, and the first light fractions go over with the water, there will occur cessations of internal action in the emulsion for a short time, and then other distillates will be given off. The observations we have made show, I think, that complete separation can be effected by careful manipulation in seven hours. We generally turn steam on at night and shut it off in the morning. We do this for convenience and thereby save labor charges, using only steam enough to accomplish the work during the night. As to the foaming effect in the wash-box,—we do not have that in the Lowe apparatus. In the Flannery apparatus the carbon is sometimes deposited on the lower edge of the dip-pipe, increasing steadily by small increments the depth of the seal, and the pressure on the apparatus back of the seal, occasionally causing trouble. In the Lowe apparatus, with large outlet pipes and shallow dips, we have had no deposition of carbon in that way, below the water. As to the capacity of 3,500 gallons of clear tar per day being the maximum efficiency, I mean that we maintained that efficiency of 3,500 per day for a reasonable period, that is, for a fortnight, on the small stated tank capacity. As to the question of a satisfactory agreement between the observed and the theoretical heat transferred in the case of cooling by air,—a reference to the paper shows the change of temperature was eight degrees; and as our thermometers did not read to less than half a degree, the best observation we could get was with not less than six per cent. possible error. I take it that in most cases readings are for the whole degree, and then it would be with not less than twelve per cent. possible error, and that gives quite a leeway. Any standard determination of specific heats would be satisfactory. As to the time of year when the best efficiency was noted,—our experience agrees with that of Mr. Morris, in that the warm weather is the time we get the best work.

The analyses given by Mr. Norris, showing no naphthalene and low lampblack, seem to me to suggest that the manner of operating the apparatus must be a very considerable factor in turning out tar of that quality. If, when properly run, no lampblack is formed, it must be in a warm climate, where the gas is not cooled very low after leaving the works. For with high heats lampblack will be made, and if made, some of it must be found in the tar. Moreover, in our system of separating the tar, we really raise the contents of the tank, or the emulsion, to a slow boiling, and a good deal of the lampblack is perhaps by that method incorporated into the tar, thereby decreasing the bulk or percentage of the tar recorded, and decreasing the amount that flows away through the waste water.

Mr. Forstall speaks of gas coming from the superheater as being, in the statement I make on page xxvi, assumed to be dry gas, without regard to the excess of steam used in the apparatus I have not disregarded that excess of steam in this case, where it is about one and one-half gallons or 13 lbs., but it involved an estimate that I will explain. The rate of make varies every minute that the run is on; and it is exceedingly difficult to get at the exact flow of water. We tried to take the readings on the station meter and observe the make of gas and observe the flow of water at the wash-box at the same time (of course, we observed the flow of water under conditions which are not exactly those of practice). The thermometer reading the temperature beyond the wash box was about eight feet above the seal, and at a point near the discharge of the gas into another and lower main. Some fall in temperature of the gas occurred in this 8′ of travel, and I estimated the drop as more than two degrees, from observations of temperatures of the gas at successive points in its flow. At 194° the gas can carry 13 lbs. more of aqueous vapor than at 192°. The rapid flow of the gas as the temperature dropped to 192° could carry this 13 lbs. of condensed vapor into the connecting main, and so from the wash-box.* Mr. Forstall alludes to the difference in weights per gallon, of the tar, and the oil from which the tar is made. Thus, the oil may weigh 6 to 7 lbs., and the tar 9 or more lbs. per gallon. But it is not known how much, if any, of the carbon in the tar is from the coal; and moreover, as both oil and tar are bought and sold by volume, it is easier and simpler to credit the oil account by volume. Assuming, however, that the tar is all a product of the oil, and computing the best net efficiency as suggested by Mr. Forstall, we find,—

for gas-oil, 22.8 lbs. give 25.5 candles.
for naphtha, 21.4 lbs. give 25.3 candles.

THE PRESIDENT:—What disposition shall we make of Captain McKay's paper?

MR. F. EGNER (Norfolk, Va.):—I think two questions were asked Captain McKay which he did not answer; they were about the water-gas tar being so much better, and getting so much more for coal-gas tar when mixed with water-gas tar. He had said that the water-gas tar improved the coal-gas tar. I would like to have him answer as to that.

MR. WM. E. MCKAY (Dorchester, Mass.):—The use of water gas has increased a great deal in recent years, as shown in the tables I have collated. It may be conjecture, but I do not think I am in error in supposing that there is a considerable amount of water-gas tar mixed with coal-gas tar which is now sold as coal-tar in the small works. I refer you to the tables showing the prices received for coal-tar (Note G, Table V, column VIII), and from them you will see that while it was 2.13 cents per gallon in 1887, when there was very little water-gas made, it rose up to 6.50 cents per gallon in 1897.

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* On October 31, 1901, placing thermometers, one close to outlet at wash-box, and one 8′ above the seal, 24 simultaneous observations of gas-temperature were taken. The thermometers were then shifted, and 24 observations taken. By these 48 simultaneous observations, it was found that the average fall in temperature of the gas in the 8′ travel was 2.6 degrees; and that when the gas at 8′ above the seal was 192°, it was 196° to 197° close to outlet from wash-box.

Mr. E. H. Jenkins (San Antonio, Texas):—This paper by Captain McKay is not only valuable for the discussion which it has brought out, but it is a paper that we can take home with us, and we will find that a number of the references given in it will be of great value. I think we should take that into consideration. I move a vote of thanks to Mr. McKay for his paper.

Carried.

The President:—We have five minutes left before adjournment, and we will take up for consideration one of the questions in the question box.

What records have we of gas holders having been struck by lightning, and what has been the result?

The President:—I understand that Mr. Robison, of Geneva, has had some experience along that line.

Mr. C. D. Robison (Geneva, N. Y.):—Last summer during a heavy storm, shortly after the lighting hour, one of our holders was struck by lightning. About that time the holder must have been forced down, so that when it rose again it put the lights out. That was about all the damage that was done. Next day I examined the holder more carefully and found a cut about ten inches long, and one at right angles to it; but the cut had closed, and only left a hole about the size of a lead pencil. I changed from a small holder to a large one as soon as the accident happened; and during the night we lost five thousand feet of gas. So far as I could ascertain that was the only damage done.

Mr. E. J. Donahue (Philadelphia):—I would like to ask if the gas went out throughout the entire city.

Mr. C. D. Robison (Geneva, N. Y.):—Our distributing system is not very large—about eighteen miles of mains—and as far as I could find out it did put the lights out that were lighted at that time over the entire city; but it was for only a moment and they came up again.

The President:—Do you mean to say that the lights were put out and then came on again?

Mr. C. D. Robison (Geneva, N. Y.):—Yes. That is, they did not light again. The pressure was off just long enough to extinguish the flame.

Mr. A. E. Forstall (New York City):—In connection with that question I have received the following letter from Mr. R. B. Taber:

Mr. Alfred E. Forstall, *Secretary*,
American Gas Light Association:

I can do little to make your meeting the success it should be, but one of the questions in the Question Box reminds me of a most unexpected event which occurred in one of the little gas works at that time owned by the General Electric Co. There had been small call for the poor oil-gas we had been able to make and many reasons concurred in closing the plant "for repairs," which were long in making, and I had as a wise engineer opened the manhole of the little "six-pence half-penny" holder, and supposed I had taken all precautions.

But I was wrong—for inside the tank was the usual layer of distilled oil, and one excessively hot summer day a thunderstorm came up in the afternoon, and a bolt followed by a bang told the knell of the poor holder, parts of which were found in one place and another, and effectually shut down the gas works. I have always thought some vapors of oil filled the open tank and the lightning fired it off.

Fortunately no lives were lost but the family next door said it was fun while it lasted.

With kind remembrances to all, I am yours,

Robert B. Taber.

Mr. C. H. Nettleton (Derby, Conn.):—I had an experience in my own home somewhat similar to that described, and I could never satisfactorily explain to myself the cause of it. The lightning struck a tree, perhaps twenty feet away from the house. All the lights in my house went out, and also the lights in perhaps ten or fifteen houses situated within a radius of one thousand feet, but there was no disturbance elsewhere. I have wondered if there was not a temporary blow when that flash of lightning came—a blow in the atmosphere—which overcame the pressure on the pipes, and put the gas out at the instant. Immediately after the lightning flashed the gas came out again.

Mr. A. E. Forstall (New York City):—I think Mr. Nettleton's theory as to the cause of that occurrence is correct. I have had a somewhat similar experience, although it did not follow a stroke of lightning. At one time in Newark just as a heavy local thunder-storm passed over part of the city all the lights in a small area went out; but the pressure came on again at once. Fortunately the gas office was included in that area and I was immediately called up over the telephone to find out what we were doing at the gas works. Nothing had happened there. Our pressure record was perfectly normal. The only explanation we could give of it was, that just as the storm came on there was in advance of it at that particular location an excess of atmospheric pressure which prevented the gas from coming out of the burners. It was over instantly and we could find no other cause for it.

MR. S. J. FOWLER (Charlestown, Mass.):—In other words your barometer went up in the storm.

MR. A. E. FORSTALL (New York City):—Not in it but just in front of it.

MR. JOHN WILLIAMSON (Chicago):—Did not something similar to this happen in Chicago?

MR. A. E. FORSTALL:—That was an opposite effect. There the thunder-storm passed over the works, but did not reach the town at all. My theory there was that the centre of the storm passed over us, causing a vacuum and lifted the holder just for a second, just took the pressure off the holder, and then let on the pressure again. In that case we were in the centre of the storm at the works; in the other case we were clear away from the centre of the storm.

MR. JOHN WILLIAMSON:—In the case I referred to the gas went out about two miles away from the works.

MR. A. E. FORSTALL:—I do not remember that particular case, but I know that we had two or three scares there, so that we made it a rule whenever we saw a thunder-storm coming up to station a man at the street main governor until the storm passed over, to be ready to keep the pressure from dropping in case it showed any tendency to do so.

MR. A. S. MILLER (New York City):—I suppose there is no harm in referring to one other point in this connection. We have a series of recording gauges scattered around, and it is very seldom we have a storm without there being indications that the barometer is different at the works from what it is at outlying points, that is, there are indications of increase or decrease of pressure on those gauges. Of course, this pressure varies with the violence of the storm, so that it would be very easy for a storm to have sufficient violence to make a difference in pressure great enough to put out the lights. In other words, two inches of water is equivalent to about one sixth of an inch of mercury ; and it is easily understood how in a violent storm the difference in barometric pressure between two points within five miles of each other might be one-sixth of an inch. That would be sufficient to put the lights out. In one of the Western states during a violent storm I have seen all the lights in one section of the town go out.

MR. A. E. FORSTALL:—In view of the direction this discussion has taken it may be a matter of interest to state that the volcanic eruption which destroyed the Island of Krakatoa was recorded on the pressure gauges of the Chicago Gas Light and Coke Company. About two o'clock one morning there came a very sudden rise in pressure above the normal, followed by a drop below and a recovery to the normal pressure. There was no satisfactory way of explaining it at the time. About a year after, my father was reading an article in some scientific journal which gave an account of the effect produced by that eruption upon the atmosphere all around the earth, as recorded on the delicate instruments which are kept at some of the observatories. He remembered the jump of pressure spoken of, thought it came pretty close to the time when the air wave would have passed over Chicago ; and by calculating the rate at which the wave traveled, from the data given in the article, he found that it was entirely reasonable to suppose that the air wave produced by the eruption passed over Chicago, just at the time that the jump in pressure occurred.

THE PRESIDENT:—The hour has arrived at which the meeting is expected to adjourn, and unless there is objection, we will now stand adjourned until ten o'clock to-morrow morning.

SECOND DAY--MORNING SESSION.

OCTOBER, 17, 1901.

The Association met at ten A. M.

The Secretary read a letter from the President of the New England Gas and Coke Company, inviting the Association, as a body, to visit the works of that Company at Everett and stating that a special train would be provided for the use of the Association, if the invitation could be accepted.

On motion a vote of thanks was extended to the Company for its courteous invitation, although it could not be accepted owing to lack of time.

The Secretary read letters and telegrams of regret from Jas. W. Dunbar, Henry G. Morris, J. M. Rusby, S. S. Stratton and J. A. Drake of Halifax, England.

The President appointed as the Committee to award the Beal Medal:

C. J. R. Humphreys,
George G. Ramsdell,
William H. Pearson.

And as the Committee on Final Resolutions:

James Ferrier,
John P. Harbison,
Isaac C. Baxter.

The President then called for the reading by Mr. E. H. Earnshaw, of Philadelphia, of his paper entitled "Further Notes on Retort House Practice."

(For Paper see Appendix page i.)

THE PRESIDENT:—It strikes me that the title given to Mr. Earnshaw's paper is somewhat of a misnomer. It should have been "A Text Book upon Retort House Practice." The paper is now open for your consideration. For the benefit of the stenographer I would like to say that unfortunately there are a few gentlemen in the hall whose names I do not happen to know, or possibly, if I know them, I cannot speak their names quickly enough for his benefit. So I will ask you, as you rise to speak, to wait until your names are announced. If you will do so, I will appreciate it. I will call upon Mr. W. A. Miller of Cincinnati, to open the discussion on this subject.

Mr. W. A. Miller (Cincinnati, Ohio):—This is a very interesting paper, and the instruction as regards the stoking of fires in furnaces of benches, the manner of working same, care of lids, pipes, etc., are in accord with the best practice; but I cannot understand why Mr. Earnshaw advises " forcing the fire in furnaces to a white heat just after the brick work has become thoroughly dry," or at any time thereafter.

As stated, too much care cannot be exercised in the adjustment of dampers and the slides controlling the supply of primary and secondary air to benches to obtain the best results.

In the number of men employed to attend to benches on the operating floor, I am particularly interested, as the cost of labor is a factor not to be overlooked, even in works where all of the retorts are drawn and charged by mechanical means.

Mr. Earnshaw states that the work of each man is the duty of attending to two benches of 9's, a total of eighteen retorts, which on four-hour charges represents the work of opening and closing an average of 4½ retort-lids per hour, together with the incidental cleaning of lids, pipes, etc., in connection therewith. As the men work eight hour shifts they therefore attend to a total of 36 charges per day each. In the closing paragraph of the paper there is a statement that " they have no trouble with stopped stand-pipes," and if that is the case why is so little work set apart for each man? In the works under my charge, the lid-men are not actually engaged to exceed twenty-five minutes per hour, yet they attend to the charging of forty per cent. more charges per man per hour, and to more than double the number per shift. In other words, Mr. Earnshaw's men attend 4½ charges per hour, or 36 per shift, of 8 hours, while our men can attend an average of 6⅓ per hour and a total of 76 per shift of 12 hours.

Mr. Earnshaw's lid-men each attend to the cleaning of six bridge-pipes, six stand-pipes, to the filling of two furnaces with the fuel necessary to maintain heats on retorts and sweep the floor in front of two benches. Our men each attend to an average of nineteen bridge and stand-pipes, to the filling of five furnaces, and the sweeping the floor in front of five benches, working six-hour charges.

Occasionally we have a stopped stand-pipe, but whether one has them or not depends altogether on the amount of labor expended to keep them open, whatever may be the condition; and, if it is necessary in any works to give to the pipes the attention outlined in the paper, it would to me be an indication of a case of stopped stand-pipes, prevented from becoming chronic by the frequent application of the basket-bull and other pipe cleaning tools.

The yield of gas per mouth-piece is given as 12,000 cubic feet. I would be pleased to learn the yield per man in retort house, including machine men, lid-men and the men clinkering furnaces and removing the coke to yard or bins.

Mr. Earnshaw states that he is using a coal which makes a pitchy tar. I would like to ask if, when the conditions are favorable, there is any coal that will not produce tar of said character.

I do not agree with the statement that the candle power of the gas produced from six-hour charges is necessarily less than that obtained from four-hour charges.

Mr. Earnshaw's paper manifests close observation and careful attention to detail while operating the regenerative benches in a large retort house; his notes are valuable, and in the light of an experience covering a period of eighteen years in works manufacturing coal gas exclusively, I commend it for the careful perusal of all members of this Association, and particularly those who are inclined to experiment with high and low heats, and charges of coal of various weights, in regenerative benches.

THE PRESIDENT:—Has Mr. Greenough something he would like to say upon this subject.

MR. M. S. GREENOUGH (Cleveland, Ohio):—I am obliged to to you, Mr. President, but I was not expecting to make any remarks. I have listened to the reading of the paper with interest, and also to the criticisms which have been made by Mr. Miller. Most of us who experimented with the benches which have been described, twelve or fifteen years ago, discovered the true path by the unfortunate accidents which happened at our various gas works. Mr. Earnshaw has also discovered that the only way of ascertaining just what a retort will carry is by rule of thumb, seeing what you can get into a retort and what you can work out of it. I do not find my own experience agreeing entirely with that which he has stated with regard to the heat which it is advisable to carry. I would like to ask him what percentage of free carbon he finds in his tar when he is producing from a retort 11,500 feet per day? It is not difficult to make retorts carry that weight of coal; it has been done in the works I am caring for, for a considerable period of time; but having regard to the quality of tar produced, I may say that we do not find it advisable to carry such a temperature on those retorts as will enable us to work off that amount of coal. I think there is something to be said in favor of longer charges, although the men do not seem to take to it absolutely kindly. It may be an interesting fact to state that after hearing of the good results, such as Mr. Miller has given the history of at Cincinnati, I tried similar experiments in Cleveland, and then had the pleasure of a strike in the entire works. The men were not in favor of the longer charges, and refused to work in that way.

I have not studied this paper sufficiently to warrant me in making any furthur criticism upon it; nor do I carry in my head some of our data regarding retort house practice as accurately as I used to do. The superintendent of our station, who had charge at the time, is here, and he might possibly be able to give some further information later.

I am obliged to you, Mr. President, for calling on me.

MR. WILLIAM R. BEAL (New York City):—I had not expected to say anything on this subject, but I feel that it is due to the managers of smaller gas works that something should be said about retort practice with manual labor. About fifteen years ago we built a house and put in it four or five types of regenerative benches. After an experience extending over three or four years we arrived at the conclusion that for our purpose a full depth setting with an outside generator, was very much the best; and we have since been using such an apparatus. I have listened with a great deal of interest to what has been said about the difficulty with tar. Before we went into this new house we had had a great deal of trouble from making pitch in the main. At that time I designed a hydraulic main with a pocket at the back which would enable us to take the thick tar and pitch from the main while the retorts were still in action. For this new house I made a very wide main, and put in the centre of it a slot through which a tool might be passed the whole length of it, so as to liberate the tar. Mr. Earnshaw is quite right in the statement that there is really no necessity for having many stopped stand-pipes. He says that in his practice stopped stand-pipes are a thing of the past. I will say that in our practice we have very few of them; and that is because we have found that as our business has grown we have been able to give to retort house practice that sort of conscientious, intelligent and constant care which it really needs. When I had to do everything myself I found that it was very difficult to do everything thoroughly well. One point of Mr. Earnshaw's statement, and of Mr. Miller's remarks is, that as business grows, each department may have such intelligent care as to make good results possible, and make the absence of them inadmissible. In our practice we now have very little or no difficulty with tar in the main, or with stopped stand-pipes. We are very careful in selecting the material with which we put up our benches, and we find that while we get as good results probably as Mr. Earnshaw does, we are able to keep these benches in continued use for quite three years. We have some benches of 9's which have been in continued use for three years this month, and which are still too good to be replaced. They will probably last us until next Spring. After I got here I sent word to our superintendent asking him to take from the books the results for the month of September; and he writes me that we made 11,410 feet for the average per retort, and per man 39,170 feet. This includes the work of four men who are employed in bringing coal from the adjacent coal-shed into the retort house, and the putting of the coke from the retort house into the cars when it is taken to the pocket. I do not think there is any question but that these results can be obtained without machinery by any intelligent man who is also careful in the selection of the apparatus and of the material, and who every day gives intelligent attention to the care of the apparatus.

Mr. Carroll Miller (Chicago):—I agree with Mr. Miller that Mr. Earnshaw's retort house labor seems to be very high, and I should say that the principal reason is on account of cleaning the pipes out so often. In my experience in works with which I was recently connected I found that with full depth regenerative benches, retorts 16″ by 26″ by 9 feet, we ran for about thirty days and never touched the pipe at all, except in cleaning the stand-pipe at the mouth-piece with what we called an auger.

Mr. Earnshaw says on page vi, that "an accurate record should be kept at all times of the amount of coke charged into the furnace, so that a deficiency or an excess of coke will be promptly noted." I have always found great difficulty in keeping that record, and I would like to ask Mr. Earnshaw just how he does it.

On page xi, he says that "the fires are shaken up every two hours." I do not understand just what he means by "shaken up."

Then in the matter of admitting steam under the grate bars: I think we could measure it if it were necessary to put the steam under, with a pressure gauge, or rather with a pressure regulator and a cock.

I would like to know how Mr. Earnshaw scurfs his retorts—just the method of doing it.

THE PRESIDENT:—Will Mr. D. R. Russell say something on this paper?

MR. D. R. RUSSELL (St. Louis, Mo.):—I do not know that I can say anything of interest with regard to the operation of benches, as my experience in the actual practice of operating benches has been very limited. I think that Mr. Earnshaw, Mr. Miller and Mr. Greenough have pretty well covered the points that I could make. Of course, I think that a good deal of the trouble with stopped stand-pipes and pitch in the main, is due to the kind of main used, and to the apparatus for taking off the tar. I think more attention is being paid to these details now than was formerly done. I believe myself that Mr. Earnshaw's point about keeping the retorts as full of coal as is practicable will do away with most of the trouble from lamp black; and then by having the proper kind of main and tar attachment the trouble with pitch can be almost eliminated. As my experience is more in the line of construction than of operation I do not know that I can say anything further on the subject.

MR. N. W. GIFFORD (New Bedford, Mass.):—I would like to express my appreciation of Mr. Earnshaw's paper, for I consider it a valuable addition to gas literature; and it is especially valuable to those of us who have not had so much experience in the newer and larger installations which are referred to in the paper. It will be of great assistance to many people as being a careful and concise record of actual work.

MR. F. EGNER (Norfolk, Va.):— I entirely agree with the President in his description of this paper, and think that it will rank as a text book on the subject treated. It contains such valuable data that it will help the younger members of this Association very much, and will, perhaps, refresh the memories of the older ones. It is of course, quite elementary.

I would like to ask for some information about the standard size of retorts. He mentioned something about that. All the manufacturers of retorts would be pleased, I am sure, if there was to be a well established standard for retorts, and all have been trying for "standard sizes." I think the retort makers would be glad to know if there is a standard size of retort; and I would like to know something about that.

Another thing strikes me: some of the younger members, or some who are not gas men, might be surprised at this certainly elementary information, and might wonder why or if we need it. A great deal of the surprise that Mr. Earnshaw mentioned that he had as the result of some of their experiments would have been unnecessary if he had remembered what Samuel Clegg had written upon that subject a good many years ago; and he will find much information upon it also in King's Treatise on Coal Gas.

Mr. Earnshaw says that, "the fact that there is a minimum allowable proportion between the cross section areas of retort and the charge was brought home to us in a vigorous and conclusive manner." To which I would say, and no doubt in a costly manner as well; and all that might have been avoided by the study of Clegg and King a little more. But the whole paper is to be commended, and will no doubt be of great value to coming generations because it describes in greater detail and in better manner the operation of the regenerator or recuperative furnaces than I have seen in any previous paper.

Mr. M. S. Greenough (Cleveland, Ohio):—When I spoke before I neglected to refer to one or two things which have occurred to me since I sat down, and which I would be sorry not to have mentioned. I must say that I think the suggestion of Mr. Earnshaw of putting into the retort something to stir up the charge does not meet with my approval.

There has been a question of practice—as to how large a charge can be put in, and what size of coal can be used and properly worked off. You can work off enough coal in one of those retorts to give a yield of 10,000 feet, which the manufacturer guarantees, without having to open the retort doors but once. Opening oftener than that, for the purpose of poking the coal, is so much unnecessary work. It might depend, however, on the coal that you used. If you use very fine coal it may be necessary. If you run against a streak of poor coal, it shows; but with such coal as we now use generally in our works we do not expect to find any material quantity of gas left in the coke after the four-hour charge. I do not think it is necessary, and I do not think it is good practice to use such coal that you cannot work it off in four hours without having to open the retort.

There is a great deal of very valuable information in that paper, and I do not know that there is any place in which you can find it all put together as clearly as it is done here. I should be sorry to have the remarks which I previously made understood as casting any reflection upon Mr. Earnshaw's experience and care in getting this data together. But, if this paper is to be used as a text book, as has been suggested, then these criticisms are to be considered also.

With regard to the matter of scurfing out retorts I would say that if a man has a large number of spare benches it may be possible for him to keep three per cent. of the retorts burning out all the time. If you are using a charging machine which necessitates the introduction of coal in a scoop, you must, of course, keep your retorts clean or you cannot use that machine. But I do not think it is practicable in running a retort house to always keep the benches cleaned out as often as Mr. Earnshaw says it is necessary.

I see nothing else about the paper to make any comment upon. I think it is a very admirable paper, and that it covers the whole ground.

Mr. A. E. Forstall (New York City):—Retort house practice has been a sort of hobby of mine for some time, and I suppose I am expected to say something every time the subject comes up for discussion.

In going over this paper I think the statement on page ii, in regard to filling a furnace the first time with cold coke, might be made also to apply to filling the furnace after cleaning the fire in those cases in which owing to a hard clean the fire has been pretty well drawn down. It is not good practice in such cases to bring in a quantity of cold coke from the yard and slap it in in order to fill the fuel bed up to the normal level. I think it is better to work it up gradually, and if necessary to put in extra coke, to put in hot coke drawn from the retorts in other benches.

With regard to the proper adjustment of chimney dampers I will say that while the test which Mr. Earnshaw recommends is the best I know of, still a man who has had some experience with regenerative benches and furnaces can always get a very good idea whether the damper opening is too large or not, by simply looking at the surface of the fire in the furnace some time after fresh fuel has been put on, say an hour or an hour-and-a-half afterwards. There is a peculiar appearance of the fire when working with a proper draft, which, while it is hard to describe, is very distinctive; and a superintendent while passing down the retort house can open the charging doors, look into the furnaces, and tell if the damper openings are right.

To afford facilities for such observations it is desirable to have a charging door that is easily opened. I do not like to have to call a man to come and take off the door every time I want to look into a furnace to see that it is in proper shape; I like to be able as I walk down the front of the stack to give the door a push with my foot, throw it aside, look in, and push it right back again. The disadvantage of such a door is that it is apt to leak; but it can be made tight.

I agree with what has been said about the amount of work required to keep the stand pipes clean. My experience has been that if you keep the stand-pipe clean there is no necessity of augering them down from the top every day. By keeping "clean" I mean never putting on a stand-pipe after it has stopped until it is certain that there is a full circular opening through that stand-pipe which is within at least a quarter of an inch of the full diameter. The cleaning of stand-pipes when the retorts are scurfed is enough to keep them clean under normal working, if they are properly augered at the bottom at every charge. The most trouble comes at a distance of three or four feet from the joint at the mouthpiece. We have found that if we removed that obstruction at every charge we did not have trouble higher up; and the cleaning of the stand-pipes whenever the retorts were scurfed was enough to keep all our stand-pipes in good order. If one of them stopped slightly it was an easy thing to clean that one; and it took no more time than if we did it every morning, while we saved time by not working on retorts that did not need cleaning.

"The proof of the pudding is in the eating," and Mr. Earnshaw's paper shows that very satisfactory results are gotten by the use of the basket-bull, as made at Philadelphia; which is a great improvement on the basket-bull used in other places on account of the tension piece through the center. Where they are made without the tension piece there is nothing at all to prevent the ribs from flattening out and slipping over any obstruction. But it would seem from the shape that it would be possible to use even the Philadelphia tool regularly and still allow the formation of ridges between the spaces over which the cutting edges pass. With an auger, if the auger is kept of full size, it is almost impossible for an obstruction to form and not be cut away. I say "almost impossible," because with the natural perversity of human intelligence the stokers will often invent ways of pushing the auger past obstructions which call for more exertion than would be required to cut the obstructions out. It is very important to keep the tool of full size. We had a couple of standard steel rings, accurately turned to the proper diameter, and it was the duty of the day foreman, when he first came into the retort house in the morning, to try those rings on every auger used. If they slipped over an auger the auger was immediately sent to the blacksmith's shop to be spread out.

Mr. Earnshaw might have emphasized still more strongly than he did the fact that burning part of the charge too much and the other part too little does not produce an average of a well burned charge. My experience is that it is more apt to produce a stopped stand-pipe than anything else.

The slicing of a charge so as to get all the gas out of it is a new idea to me, and yet it seems as if it might be a good idea in view of the proper relation between the cross section of the charge and the cross section of the retort. I will come to that later.

As to scurfing retorts, I agree entirely with Mr. Earnshaw. I think it much better practice to have a certain percentage of your retorts out all the time—the percentage to be determined by the rate at which the retort closes up with carbon—and know exactly what you can depend on making every day while keeping the retorts always in the same condition. I must say, however, that I have always had an auxiliary water gas plant to take up the fluctuations in make, and so have never had to face the alternative of either missing a number of charges or putting in a number of "scurfers" to keep the holders from blowing on Monday afternoon.

As to the proper relation between the size of cross section of charge and the retort, somewhere between 1885 and 1890 a German, I think it was Herr Kunath, published a paper detailing an extensive series of experiments with reference to that point. He was troubled with lampblack in his tar, and with stopped stand-pipes; and with the usual German thoroughness he went to work to find out what produced those conditions. The result of his experiments was that there was a proper size of cross section of charge for every size of retort, which should be determined in fixing the proper weight of the charge. (Of course, under normal conditions the proper weight would always give the proper volume.) The ideal way theoretically to work the retort house and get the best results would be to charge the proper weight of charge, and let it go whatever time was necessary to burn it off. Of course, he realized that in practice this could not be done, but that there must be a fixed time, fairly well divisible into twenty-four hours, for each charge; and as the alternative he recommended that the charge be made as large as possible for the size of retort, and that the heat be kept such as to burn that charge off within the fixed time.

My experience seems to bear out that theory. The more completely a retort is filled, the better are the results obtained, and there is less trouble with the stand-pipes and hydraulic mains and with the general work around the retort house. That has led me to believe that many are making a mistake in the size of the retorts which they put in, especially in smaller works. I have lately come across benches which at the outside would not burn off per retort more than 275 lbs. of coal in four hours and yet were set with 16″ by 28″ retorts, which is entirely wrong according to my idea. In some benches of 9s at Newark it was necessary, in order to secure combustion chambers of proper size, to make the retorts in the lower tier smaller than those in the upper tiers. Where we had retorts 16″ x 26″ in the upper, we had 16″ x 24″ in the lower. The 16″ x 24″ retorts did just as well as the 16″ x 26″. They could burn off the same amount of coal without any trouble, and generally the results of the work would be better. I think, instead of going in for large retorts, regardless of other circumstances, the tendency should be to cut down the size of the retort. In Mr. Earnshaw's case I think he would have obtained better results with smaller retorts.

Mr. F. Egner (Norfolk, Va.) :—I may be referring to a different German from the one mentioned by our Secretary, but I think the paper to which he referred was written by Herr Liegel. I made a translation of it which was published in the American Gas Light Journal. It struck me as being such a valuable paper, as answering so many questions, and giving the remedy—for it not only describes the malady but it gave the remedy for it, that, as Mr. Forstall states, with the usual German thoroughness, I went to the trouble of translating it, and it was published in the American Gas Light Journal. I may say to all who are experiencing such trouble and difficulty in the retort house, that it will pay them to read that paper, if they have not already done so.

Mr. A. E. Forstall :—Mr. Egner is probably right as to the author of that paper. I was speaking from memory, having read that before I got into the habit of indexing.

Mr. R. M. Searle (Mount Vernon, N. Y.) :—Those of us who know Mr. Earnshaw know that he must have worked for the highest efficiency and for candle feet as well.

By slicing the charge before the expiration of the carbonizing period, Mr. Earnshaw must get more candle feet. The heat obtained during the first three hours of the charge, depends as much on reflected heat as it does on radiated heat; as the top of the charge becomes higher in heat the incandescent mass fuses over, then the entire charge must get less heat. The gas that comes off from the centre of the charge during the last hour must pass through this incandescent fused mass at the top and the Hydro-Carbons passing through this highly heated fused mass must necessarily be destroyed, and increase the free carbon in the gas, and if the charge is broken up at the end of the third hour the centre of the mass is being exposed to reflected heat and the remaining gas is allowed to get away freely and uninterruptedly without its light-giving qualities being totally destroyed.

Therefore, Mr. Earnshaw must reduce the amount of free carbon in his tar and increase his candle feet and reduce the number of stopped stand-pipes by slicing his charge.

Mr. F. B. Wheeler (Binghamton, N. Y.) :—I cannot quite agree with Mr. Searle's remarks about Mr. Earnshaw's slicing. I think that slicing is absolutely and entirely unnecessary. I know of some works that charge 450 pounds to the retort, which never do any slicing and never have any stopped stand-pipes to speak of either.

Mr. Wm. H. White (New York City):—I cannot for a moment hope to add anything to the real value of the knowledge which the several preceding speakers possess as to present retort house practice, for my retort house practice, like the future of the man of whom the genial Artemus Ward remarked, "that man's future is largely behind him," is largely a matter of reminiscence and observation. But I wish to pay my personal respects to the writer of this paper, which has called out such an interesting discussion, and thank him for a very pleasant half hour. Sitting here I have been thinking of the old days when I was superintendent of a coal gas works and really thought that I knew something about retort house practice. I was one of the earlier of the gas men who believed that higher heats and greater yields were possible and undertook to demonstrate the faith that was in us. Alas, those were the days of experience and history-making indeed.

In them I laid the foundation of my suit of gray hairs, for the children begot by that marriage of "heats" and "yields" were with me hourly. I supped full of sorrow with that infant naphthalene and shook hands in grief with its brothers stopped stand-pipes and choked hydraulic mains.

Those were indeed "Long days of anguish and nights devoid of ease," when I saw my modest retort house gang spend as many hours on top of the stack of benches as they did on the charging floor. My then neighbor and that best of gasmen, Mr. Eugene Vanderpool, reached about the same time the conclusion that we could get five feet of gas to the pound of coal—well, we could, and did, but we grew sad-eyed watching the nursery that we let loose into the gas world when we so gaily lifted the lid of that Pandora box of assorted worries we then so thoughtlessly dragged out of our inner consciousness. The many burning letters and the interviews that those early efforts brought about would be interesting reading for us all to-day. I am here reminded of the minister who in preaching upon the creation, said, "God made the earth, pronounced it good and rested; then made man, pronounced him good and rested; then he made woman and justly pronounced her good, but since that time neither God nor man has rested." Since our thoughtless addition to retort house practice, good as it was, not a gas man has had time to take his eye off of the retort house and rest.

It has been very interesting to me to sit here while this paper and the discussion of it, commanded attention, and to think how we have gone on, year after year, just as we began in the early days of this Association, discussing the same old, old story that seems ever young and always interesting. The story of our daily efforts. We come here with the harvested experiences of the year garnered in the store house of our memory and lay the sheaves down upon this threshing floor of the Association that our fellow members may help us thresh out the golden grains of real value and winnow them free from the chaff. Even though in this process we do often thresh over some of the same old straw, here and there a kernal of value can still be found. I have felt, as you have talked, that a valuable object lesson was being lost by those Presidents of gas companies who cannot see any good results arising from such meetings as these and who decline to pay the expense of sending their engineers to meet with us. Purblind managers they are who think in their hearts that we here do nothing but tell each other stories, sit around hotel offices, or in another apartment of the hotel watch curious minglings of pink and spicy compounds, or say soothingly, "I will take sugar in mine." Could such presidents have spent this last instructive and interesting half hour with us, they would be greatly enlightened and feel that the expense of sending their engineers here would be amply reimbursed to them in the improved results had in their own works in the future. For such valuable purposes are these meetings held and to such useful results do we all strive. When you go back to your homes and once more place your hands upon the lever of control at your works, you do so better qualified to meet your duties intelligently and carry back with you a wider and kindlier knowledge of these your fellow workers in our industry. Besides this, you also carry away, I hope, that jewel of inestimable value in your further struggle for success—the knowledge that you do not—and, cannot, know it all. I have come to these meetings from the earliest day. Stood by at the birth of the infant association and helped wrap it in its first swaddling clothes. I have been with you ever since, and I hope to be spared to meet you for many years yet to come, and I have never left a meeting without the sense that I have advanced somewhat in my knowledge of our business. It is a memory mingled with pleasure, and some self pity, with which I recall those far gone days when, with a sense of importance, due to youth and its vast inexperience, I occasionally sat by some modest gray-haired brother, whose worldly experience had centered in and around a gasworks, and from the resources of my greater knowledge of the world, broader education and thorough saturation of the technical and chemical shibboleth of the business kindly endeavored to open new avenues for his thoughts and to teach him something about his business. Dear old friends, how kind and considerate they were! Knowing more of the real thing in five minutes than I did in as many hours, they rarely speared my conceit with the naked truth. A merciful Providence permits young men to grow older, and in the process to eliminate from their mind that sense of "know-it-all" that is as a stumbling-block to our feet when we first set them upon the hill slopes of human endeavor. Youth is a disease from which we all must suffer—it is a disease many men happily never survive, but to those who reach mature years and look back at the things, wise and unwise, which we said and did, we can rejoice in, while we wonder at the kindness and forbearance of the gray-haired men of those days—that they did not rise up in their wrath and kill us then. What has been brought out by this paper, and its discussion, again proves the truth of the old proverb that, "when all is said and done, there is nothing new under the sun." These younger members of today, highly equipped for their life work through the modern magnificent technical schools and their opportunity of special training under skillful engineers, have dropped in here, to-day, to tell us old fellows what we knew and did thirty years ago, and then proudly read about it to our fellow members. I see about me a dozen men whom I might readily name, who fought out the good fight of the varying size of "charges," varying length of carbonizing periods, large and small retorts, how to care for the tar and pitch and lure to rest that sooty fairy, lamp black, that like the wind goeth whither-so-ever it listeth. They then proved to the dot of an I the exact values of their several methods and how to do and how not to do it all. Oh, young brothers, maybe you are even now awakening to the fact that, interesting as it all is and always will be, these themes are as old to us as are the sweet nothings we've whispered to the gray-haired women who still bless our lives when we courted them, lang syne. But don't think me ungracious.

I thank Mr. Earnshaw for the opportunity he has given to me this morning of living once more for a brief time, in the past, with its struggles, its success, and its failures, but most of all do I thank him for the memory which has summoned back to me the long gone friends of those days of strenuous endeavor.

I appreciate now the sentiments of the passenger on the ferry of Canon Kingsley's poem, who tendered thrice his fare to the aged boatman because "Spirits twain have crossed with me." And, now, may I say in closing, that while I look back to my past retort house practice and recall the genial able men who were then making precedent for you and firmly establishing our profession among the greater industries of the developing nation, I do so with a peculiar sense of gratitude to them for their valued teachings and for friendships most charming in recollection, I am like that man who said, "I care not who makes the laws, if I may write the songs of the people," for just now I care not who manage the retort houses of the country if you will only kindly permit me to build them.

The President :—We have no disposition to curtail this discussion, but unfortunately we have more business than time in which to attend to it. I would ask Mr. Earnshaw to reply to some of the questions.

Mr. E. H. Earnshaw (Philadelphia) :—The question of labor has been made quite an important part of the discussion. I did not intend in my paper to go into that question at all. I simply mentioned the fact that we had two men to four benches of retorts so that I might emphasize the fact that certain men were called upon to attend to certain duties, and were held responsible for those duties. The number of men required to run a retort house varies so much with different local conditions, and with the kind of men, that I think any discussion of the subject entirely unnecessary.

With regard to Mr. Miller's remarks about forcing the fire to a white heat after the brick work is dry—that is a matter which requires some explanation. If the fire is kept quite low in the grate, as it will be necessary to do if sufficient air is always to be admitted above the fire, we have to maintain the coke at a high temperature in order to raise the brick work of the combustion chamber to a good red heat before any gas is allowed to ignite at that point.

With regard to the pitch and tar, I will say that I agree with Mr. Miller that all coal will make pitchy tar under certain conditions, but I also want to say that some coal will make pitchy tar much more readily than other coal. I think that is a matter not to be denied.

The amount of coke used, and the manner of keeping a record of the amount of coke used, has been touched upon by Mr. Carroll Miller, and I think that I have said that an accurate record is a difficult one to keep—that is, accurate enough to figure from that record the percentage of coke used in the furnace; but it is not a difficult matter to keep a record of the amount charged into the retorts, so that some indication may be had of anything which is radically wrong, or out of the normal in the operation of any bench. The record may not be close enough for accurate percentages, but it will be close enough to show any important variation in the amount of coke used in any one bench.

The scurfing of the retort is done in a manner with which Mr. Miller is familiar. In our case we have a good supply of old 3-inch cast iron pipe, and the steam is admitted through that, and the air drawn into the retorts. The description of the amount of work that we do to keep our stand-pipes clean sounds much greater than it really is. The long basket-bull is forced up the pipe once in twenty-four hours, at the time of cleaning the bridge pipes, and if there is no obstruction in the pipe, the force required in using the bull is insignificant. If there is an obstruction there, it is time to get it out then and there. For that reason we take the precaution once a day to make sure that there is no accumulation beginning to form there. The object is to keep the accumulation from beginning to form; to take it in the earlier stages, and get rid of it then.

Mr. M. S. Greenough (Cleveland, Ohio):—Do you mean that the amount of carbon in the tar will vary?

Mr. E. H. Earnshaw:—The amount of free carbon will vary very much. I do not think it necessary to say how much, but as I said before, it is anywhere from twenty-five to thirty-five per cent. according to the yield and kind of coal. We are able to say that the tar is all right; but the exact percentage of the carbon is a variable quantity.

Mr. M. S. Greenough:—I am afraid I must insist upon my point—that you are getting more from those retorts than I think is justifiable, and at the same time make good tar and good gas. I think thirty per cent. of free carbon in your tar is too much.

Mr. E. H. Earnshaw :—I think the question is simply one of local conditions. It depends upon whether gas is your product and the tar your by-product, or whether gas is the by-product and tar the product. If your local market for tar is so good that you can afford to cut down upon the gas results in order to get good tar, the criticism is entirely correct. But those are questions which must be determined by local conditions, and by every manager for himself.

Mr. J. P. Harbison (Hartford, Conn.) :—I would like for the benefit principally of the men in this Association who have become members within the past five years to say that it is a very interesting paper to which you have listened, but it treats of matters that specially interest perhaps only half a dozen in this Association, in their practical workings. But the fact is that the number of you who can afford to have regenerative furnaces and working appliances in your retort houses is comparatively few. The business does not justify the necessary large cost of installation and working it. To the younger members of the profession I want to say that the statements which have been made, and the evidences given you of the great labor, care and experience necessary to properly manage the retort house, and which is experienced by those who have regenerative furnaces, need not discourage you at all. In my opinion it is not at all necessary or desirable in works of average size, down to the smallest, to have regenerative furnaces. We have had our experience with others on this same line. We have had regenerative furnaces, and the stack still stands there, but there are now no regenerative furnaces in them. They have been eliminated. Half the depth of the furnace has been built up solid, and above that we put our furnaces—plain, open settings, of our own construction, and they have six retorts. We have no difficulty in getting from them 10,000 to 11,000 feet per mouth-piece in twenty-four hours; and we are doing it every day right along, and we are getting a good yield.

I have no prepared statement to make in reply to the excellent paper to which we have listened, because I had not given it much attention; but several gentlemen have spoken here of various interesting and unsettled matters. One great bug-bear seems to be choked stand-pipes and tools and means for keeping them clean. The very best tool that we have yet discovered in our more than a third of a century of practice has been rest for twelve hours on every Sabbath day. When in the morning our lids are struck we open the cover at top of stand-pipe and let it burn out during the twelve hours when the retort house workers are at church, or looking after their families; and between that Sabbath and the next we have very few choked stand-pipes. I do not agree with my friend, Mr. Forstall, that Monday morning of each week is the time to have our holders full. Saturday night is much better; and then allow them to be low on Monday morning, because you have not made gas on the Sabbath, and it is not necessary. It only requires storage room. We do not work on Sunday in order that we may have time during the week to make repairs when our holders are full. That is not a good plan. That is the best way we have discovered of keeping the stand-pipes clear.

There are some distinguished men connected with this Association who will tell you all about tar in hydraulic mains. When we built a stack of benches we were advised by some of our friends to put in an inclined main; and from their statements we were inclined to do it. We did do it. We were assured, and the statements were made in an open meeting of this Association, that after a month or more of work, a pine stick, of fresh pine, pushed down into the main at the outlet, and withdrawn, would not have half an inch of tar showing on the end of the stick. The tar all ran off. It was known as the Stiness main, and was invented by our late lamented friend of Pawtucket. I bought one of those mains and had it put in. We have worked it since, and work it to-day, and have had pockets put on the back of it, so that we can stir up the tar and keep it moving from the main while we are making gas. We have had that main filled with pitchy tar, so that we could not force the gas out of the retort, and we had to stop the work and call in a gang of men from the street, open up everything, take off every bridge-pipe and dig out that pitch. The putting on of pockets remedied that.

Young men of the profession—do not get discouraged. Eternal vigilance is the price of success to the gas man. You will not have to work during the next twenty-five years more than twenty-four hours a day if you are reasonably industrious during that time. I wish you success. We have been ever ready, from the experience which we have gained, to do all we can to help you over the sharp points and rough edges.

Mr. E. H. Jenkins (San Antonio, Tex.): I move a vote of thanks to Mr. Earnshaw for his paper.

Mr. W. R. Addicks (Boston, Mass.):—In seconding that motion I want to congratulate the writer upon not only writing a very interesting paper, but in getting Captain White and General Harbison to give the discussion a touch which brings us all together as one. I cannot help also congratulating him upon avoiding answers to the questions asked as to the percentage of coke which he obtained, the cost of retort house labor and the amount of fixed carbon in his tar.

Mr. A. E Forstall (New York City):—Before the motion is put I would say that I think General Harbison is mistaken in his idea as to the number of people who are interested in this paper, through an interest in regenerative benches. I am certain that more than six of the gentlemen here present are interested; I am certain that at least ninety-five per cent. of the coal gas men should be interested. I do not believe there are two per cent. of the coal gas works in this country which would not be better off with regenerative benches.

The motion was carried.

The President:—Next in order is the Report of the Committee on the next place of meeting. Mr. Jenkins is Chairman of that Committee.

Mr. E. H. Jenkins:—The Committee, after duly considering the several cities proposed or suggested by members of the Association, unanimously recommend that the next meeting be held in the City of New York.

Mr. Wm. H. White:—I move that the Report be adopted.

Carried.

Mr. Wm. R. Beal (New York City):—May I say a word? You have all noticed how very emphatically our Secretary, Mr. Forstall, voted in the negative on that motion. Mr. Forstall represents quite a number of very earnest and able members of the convention who feared that the blandishments of New York society, the beauty of its scenery, the splendor of its buildings, the character of its amusements, etc., might keep the members, notwithstanding the fact that they are very earnest members of this Association, from attending at the sessions of the convention. I cannot believe that that is so, and I ask you now to make up your minds, and to keep in your minds through the year, a fixed determination to attend every meeting, to go early and to remain throughout the meeting, when you come to New York, and then have your good time after the sessions of the convention.

MR. W. R. ADDICKS:—I want to say that the President Elect need not be worried. All he has to do is to look around and see how many people are here present—and this is Boston!

THE PRESIDENT:—These remarks are extremely pleasing. I am a great believer in having warmth, and in exerting warmth; and if there is anything that the Association needs it is more warmth, and the standing together closer than has been the habit of this Association in years gone by. I agree with what one gentleman has said, that a few of these side remarks, although not pertinent to what is before the Association, are extremely interesting, and I believe that they do us good as individuals, and as an Association.

Is the Committee on the President's Address ready to report?

MR. WM. H. WHITE:—Mr. President and gentlemen of the Association. Your Committee upon the President's Address begs to make the following report. The President's address, which is marked by a careful and intelligent treatment of the topics touching our industry, presents his views in a practical and conservative manner. The several valuable suggestions of the address, while apparently not calling for action by the Association at this time, are commended to the thoughtful consideration of the members; and your Committee suggests a careful reading of the views expressed by the President upon the subjects of: Street Lighting by Gas; High versus Low Candle Power; Gas Advertising; Taxation of Franchises, etc. Some of the topics may well be made the basis of valuable and interesting individual papers to be presented at future meetings of this Association. To all is commended the strong presentation of the care of gas works surroundings, with the beneficial effects not only upon our employees, but upon our neighbors, and of the relation of employer to the workman; both may be mutually benefited by an earnest effort to bring them closer together upon the plane of manhood and mutual helpfulness. Your Committee submits the whole highly practical and interesting address to your careful personal study without further comment.

Respectfully submitted by the Committee.

MR. J. P. HARBISON:—I move that the Report of the Committee be approved and recorded in the minutes.

The motion was put by Vice-President Beal and carried.

THE PRESIDENT:—We have hardly time to take up a regular paper, and I will call for a short topic—the "Bagging of Live Gas Mains," which will be read by Mr. Walton Forstall. It was written by Mr. P. H. Gibbons of Philadelphia.

MR. WALTON FORSTALL (Philadelphia):—One of our street foremen, Mr. Gibbons, has designed a little instrument which he calls a "bag fork" for use in putting bags into a main, and we thought it might be useful to the Association to bring it before them and put it on record. I will read what he has written about it:—

BAGGING LIVE GAS MAINS.

By P. H. GIBBONS.

"A complete and successful shut-off depends more upon the proper placing of the bag than upon the lung power of the person who inflates it. Upon the rapidity of the operation quite frequently depends the operator's capacity for labor during the balance of the day. If he makes three or four unsuccessful efforts to bag a main against strong pressure his companinons either pull him out of the trench, or he staggers out himself, weak-kneed and sick, a violent throbbing headache is his portion for the balance of the day, which makes it physically impossible for the poor fellow to render you little more than fifty per cent. of his labor efficiency.

"It has ever been to me, and perhaps to all of you, a deplorable sight to see workmen overcome with gas on crowded thoroughfares, where a gaping throng is sure to quickly gather, and they are never slow in expressing their sentiments of adverse criticism touching the 'carelessness of the foreman, the neglect of the company, and the vileness of the stuff they are selling for gas.'

"I have given the subject of bagging live gas mains some thought, and while I have accomplished little in the right direction, that little will perhaps arrest the attention of brighter minds, with the result that this portion of main laying will be made pleasanter and safer for the workmen, and less expensive for the company.

"The mains most difficult to completely shut off are those that are filled with dry scales of naphthalene and rust. A rubber bag that is soft and pliable makes the best stopper for a main of this character, and it should be so placed as to get an even pressure at all points of contact. Old mains are frequently found to be very rough on the inside and have little barnacles of dried-up tar; some of which are porous, which add to the difficulty of bagging off. A rubber bag makes the best stopper for a main of this character.

"The rubber bag does not make a safe nor a reliable stopper for a main that is imperfectly drained, especially if the liquid contains oily matter. The oil dissolves the rubber and bursts the bag. A stopper or a canvas bag works better in a main of this character.

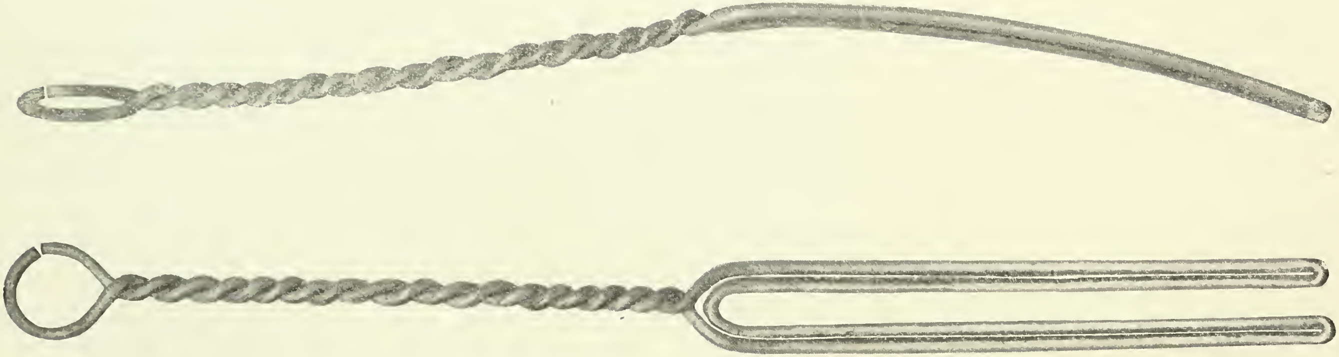
"After the main is cut, and the deposit drained off, a rubber bag can then be safely placed in the same hole with the stopper or the canvas bag.

"We have an established rule here to place two bags in each open end, so that if an accident happens to one bag, the other will take care of the gas.

"To rapidly and accurately place bags in live mains so that when inflated the axis of the sphere and main coincide, I have designed the 'City District Bag Fork.' When the bag is thrust through the bag hole, the prongs of the fork can be readily slipped over the bag stem, close up to the pole of the bag, a distance a little greater than one-half the diameter of the pipe, or just enough to allow for the angle formed by the bag with the bag hole. The bag is then carried forward into position and a luting of clay placed over the bag hole prevents further escape of gas while the bag is being inflated.

"I have used the fork daily on intersection work since the 26th of August. During that time I had to deal with mains from 2″ to 30″ and have not had a man to complain of headache caused from escaping gas. I find that any of my laborers can readily place a bag accurately with the fork.

"The fork is made of wire which gives the prongs greater flexi-



Bag Fork (Half Size).

bility than could be obtained from solid material. It is simple of construction and offers no square or sharp edges to injure the bag.

"The fork accompanying this paper is made to readily pass through a 1″ brass "Bag Saving Device" and will handle 3″, 4″, 6″, 8″, 10″ and 12″ rubber bags. The stems of canvas bags being larger and more cumbersome than those on rubber bags, they require a fork with wider space between the prongs."*

"On intersection work, we frequently find it both convenient and economical to drill one bag hole in the centre of the cross and make one bag shut off all the gas coming from three directions, but if necessary to use more than one bag, the fork enables us to place a separate bag at each branch while we are cutting and removing the iron and lead from the other.

"I always use a rubber bag for this purpose, one size larger than the cross to be bagged off, and put it straight down, holding the pole of the bag well up against the bag hole while it is being inflated. In this way I invariably make a complete shut-off. There is extreme danger, however, of puncturing the bag while cutting the old spigot out of the bell unless the bag is protected in some way.

"To shield the bag and give added security against accidents, I have designed the 'City District Bag Shield,' which consists of a piece of steel spring wire, shaped to snugly fit the main, a piece of oiled canvas being drawn over the ring. The ends of the wire are bent outward, so that they can be grasped with the thumb and forefinger; when it is desired to put it in position the ends are pressed toward and overlapping each other, which reduces the size of the ring and permits it to enter the pipe. By putting a light luting of soap around the edge, the shield not only protects the bag but the workman as well, since it will prevent all escape of gas that might pass the bag.

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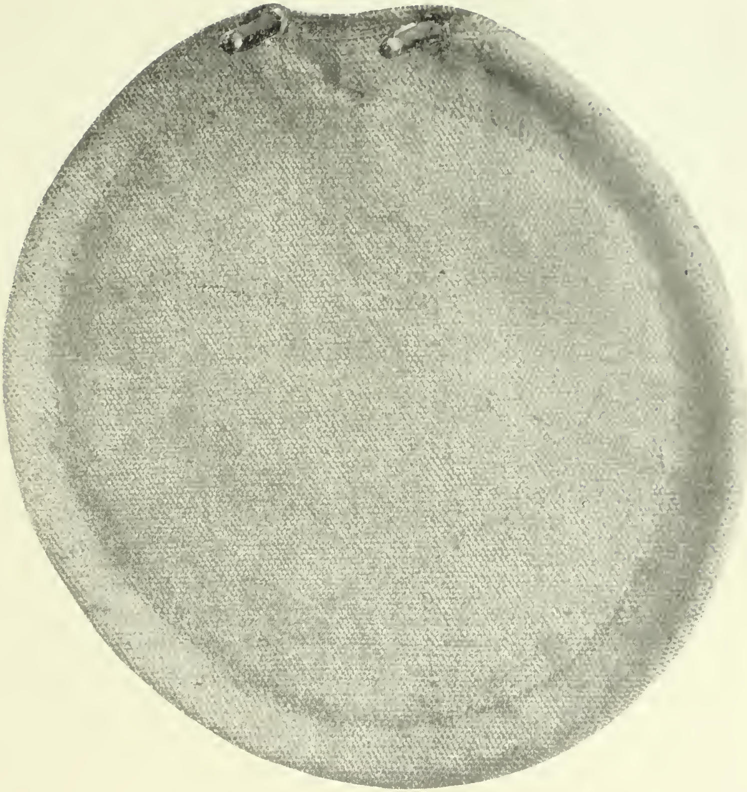
* EXPLANATION BY MR. WALTON FORSTALL:—If you will imagine this fork going through a hole in the main, or already in it then my finger will represent the tube of the bag. The tube of the bag comes out through the prongs of the fork. I push this fork over the tube until the tube has reached a point in the fork which is slightly greater than the half diameter of the main. In other words, if it is a four inch main that we are bagging this tube will be gripped by the fork about 2½ inches from the end of the fork. The tube is gripped by the fork just enough to hold it firm, but not enough to keep the air from going through the tube. Then when the bag is blown up you are bound to have the axis of the bag coincident with the axis of the main, because you have fixed the position of the tube, and therefore of the bag, by the grip of the fork. The length of the prongs of the fork must always be something more than half the diameter of the main in which you want to use it.



BAG SHIELD.

"In bagging the arm of a 6″, 8″, 12″, 24″, or 30″ cross or tee, I prefer to drill the bag hole close up to the bell and use a rubber bag a size larger than the arm, holding the pole of the bag well up to the bag hole while inflating it. I then secure it by means of a piece of twine tied to the bag stem."

Mr. Walton Forstall:—The object of this shield is to protect the bag while the pieces that are left in front of the bell are being removed.

Mr. W. R. Addicks (Boston):—He refers to using two bags, and then speaks of using this disc. As I understand it the disc is in lieu of the second bag?

Mr. Walton Forstall:—No; the disc is not made so as to go into the hole at all. It has got to be put in after you have broken your main. The disc is put into the main where you have an opening, so as to protect the bag. If you imagine that the main has been cut two or three inches in front of the bell of one arm of a cross, and the problem is to take out the piece of main which still sticks out of the bell, this will give you an idea under what conditions the shield is used. It is shoved through the cut end into the arm of the cross, being placed just back of the bottom of the bell. With it in this position, you can hammer your piece out, or chip it out and be dead sure that there is no chance of any broken pieces striking the bag in the cross, which, under certain conditions, might be only a few inches back of the bell and be liable to injury were it not for the interposition of this shield.

Mr. W. R. Addicks:—Either Mr. Forstall does not understand me, or I do not understand him. In connection with that paper he stated that in bagging off mains they used two bags—one at each end of the pipe. I thought that the disc that he has referred to was in lieu of using the second bag; but, in place of that, I understand they use two bags, and this disc is simply for the protection of the primary bag. Or, do I understand that they only use one bag?

Mr. Walton Forstall:—I have written exactly what Mr. Gibbons dictated, and I did not realize that there was any inconsistency. He uses two bags when he has the room; and if he is bagging at a cross he has one bag at the centre of the cross to shut off all the gas coming from three directions; and he has a bag in the arm of the cross, just stopping up one arm. If he has not room for the two bags only one is put in, then the disc is put in as a protection to the bag nearest the cut. If the bag breaks you could not get much gas through this disc. The trouble with some of our mains is that there is so much stuff in them that we cannot with a stopper stop the gas as well as we can with a soft pliable bag. In new mains we do not use bags at all, but use a stopper, because there we have a clean bore in which a stopper can be used.

Mr. W. R. Addicks:—I quite agree with everything that Mr. Forstall has said. I spoke of this because in many cases we use two bags also, but only in the case of large mains; and I wanted to understand the use of this disc. I now understand that it is used as a protection to the first bag rather than to take the place of one of the bags. I quite agree with him that a soft rubber bag would do better work under all circumstances than any other bag which can be gotten up. In Boston, as a rule, we have a valve; and in the case of large mains we use a bag also, in addition to the valve, simply to keep the air out of the large pipe and to prevent any leakage from the large valve, maintaining a vent between the gas gate and the bag. In the business district we find we cannot use these valves while making connections in ordinary cases because the large use of gas during the daytime would inconvenience so many consumers. So, notwithstanding the fact that we have valves at street corners we are not always able to use them exclusively in making connections.

Mr. T. Littlehales (Syracuse, N. Y.):—My own experience has been in favor of something simpler and less expensive than a rubber bag. While I have found them absolutely necessary for larger mains, I have found that with smaller mains a simple ox bladder is the best thing I could get. We always keep a stock of them on hand in a jar filled with methylated spirit. They cost a mere trifle, and as a rule, they will last longer. I have found a single bladder to stand longer than any rubber bag I ever had. The greasy nature of the thing itself often saves it. If there is a slight projecting sliver in the iron it will cut the rubber. For anything larger than 6 inches diameter the bladder is impracticable; but for smaller mains I consider the ox bladder the best thing extant to-day. It is less expensive, and there is no possibility of the oil injury as with the rubber; and if the bladder is not overblown it is astonishing what an amount of strength it will have. I have used them for twenty-five years and have found them to answer most satisfactorily.

On motion of Mr. Miller the thanks of the Association were voted to Mr. Gibbons for his paper.

The President:—We have a few minutes left before the adjournment, and we will take up one of the questions for consideration:

Do many gas companies carry liability or accident insurance; and is such insurance necessary or desirable for gas companies?

Mr. H. A. Allyn (East Cambridge, Mass.):—To fill in the gap I will say that our Company, for some fifteen years or more, has carried these policies. At the present time I think we have three classes of policies. The first one we took out was to cover a case of accident to any of our employees. The next one, I think, was for the protection of the Company in the case of any person, for instance, falling into our trenches in the street, or a carriage falling into a trench. Now we have another policy which I am not so clear about, but I think that is for any accident caused by any negligence of any of our employees outside the works. For instance, we had a case where one of our teams came in collision with an egg peddler, and we were called upon to pay for forty or fifty dozen eggs; and we have found this form of policy at times very advantageous to our company. On the first form of policy we took out, I think I can safely say that in the first two years the company made a saving of between five and six thousand dollars, which we would probably have had to pay in damages if we had not been protected by the insurance companies. They have always acted very manly in their business relations with us, and whenever a loss has taken place they have protected us in every way, and have paid the losses without murmur. We should hardly feel that we were doing our stockholders justice if we did not carry some of these policies.

MR. W. G. AFRICA (Manchester, N. H.): — Our experience has been that the company is not justified in carrying accident insurance. We have carried insurance, and have found that it did not pay us. We save money by carrying our own insurance. We have gone for some twelve years without insurance, and believe that we have saved considerable money thereby.

MR. N. W. GIFFORD (New Bedford, Mass.): —The phase of the question which struck me was the *policy* of carrying such insurance; for it occurred to me that by carrying such insurance the men were being educated to a distrust of me and of their relations with the Company. I think in every instance where an accident occurred at the works, and was investigated by the insurance inspectors, the report came back "The man has no claim. Pay him nothing." Consequently the men would take no risks. That touched a personal chord with me, because I sometimes get into places where I want to be able to rely upon my men, and want them to stay with me. The result of insurance has been, or the tendency has been, to destroy the reliance which I had in my men.

MR. H. A. ALLYN :—I differ with Mr. Gifford in experience. We have had during the last five or six years repeated accidents, and I know that our men have really felt grateful to us for the work we have done with the insurance companies in persuading them to pay the men, in some cases, quite large sums of money, when in reality the injured man had no legal claim upon the Company, because the accident might have been occasioned by his own carelessness. But the insurance company has always shown a liberal disposition. In one case we paid a man something like $175, besides his doctor's bill, and it was repaid by the insurance company. It was in a case where the man had no claim whatever—no legal claim against the Company. There had been simply a momentary piece of carelessness or recklessness on his part which had resulted in an injury.

Mr. N. W. Gifford:—I think the Company which has just been spoken of has had better luck respecting insurance collecting than others have had. There may be an exception in Mr. Allyn's case, but as a rule a liability insurance company does not pay any claims that it can possibly get out of paying. It would rather make a man fight, than pay, if there is a chance of getting out of it.

The Association took a recess until 2 o'clock p. m.

SECOND DAY—AFTERNOON SESSION.

The Association met at 2 p. m.

The President: Some of the gentlemen have been delayed in coming from lunch, and we will delay a little the reading of the first paper, but will take up a question from the Question Box:

Is it safe to use incandescent electric lights in a purifying house, the switch-board being outside of the building, and the wiring in iron pipes?

Will Mr. Witherby answer that?

Mr. E. E. Witherby (New York City):—I do not think there is any question about it. I think the experiments of Mr. Butterworth, at Columbus, would answer that question fully. In those experiments he went so far as to take a vessel filled with gas, drop an incandescent lamp into it, and then explode the lamp. In other words, smash the bulb. That extinguished the light, but with no results whatever. There might be a possibility, but never a probability, of any accident happening from an installation of that kind, provided the wiring has been done properly. All the switches, and every connection where the copper is to be exposed, must be outside of the building; then, with moisture-proof sockets on the inside which are gas-proof as well, the question of danger is entirely eliminated.

MR. C. W. HINMAN (Boston): —I have not had charge of gas works, but speaking from what knowledge I have I would say that it is a safe installation and is a very desirable one, to use for lighting the purifying house.

MR. E. E. WITHERBY :—I would state in further confirmation of that, that without an exception every purifying house that we have that is in use, and in fact all other portions of the works, are always wired, and incandescent lamps are used everywhere. It is a thing I would recommend under any and all conditions.

MR. E. J. DONAHUE (Philadelphia): —I would like to ask what the equipment is; and if the wire is in pipes?

THE PRESIDENT :—The question assumes that the switch-board is outside the building, and that the wiring is in iron pipes.

M. E. J. DONAHUE :—I think it is perfectly safe provided you use what is known as keyless vapor lamps, for then there is no possibility of a spark inside the house. Of course there is the possibility of a man carrying a bar or ladder around in the purifying house, and by accident breaking a globe. In that case there would be an explosion, if an explosive mixture is present. I think it is perfectly safe and recommend such installations. I wish to state further that if there are lamps in the purifying house which are equipped with keys, and if the wiring is not enclosed in pipes, it will be very dangerous to illuminate the purifying house with electricity.

MR. L. D. SPRAGLE (Johnstown, N. Y.):—My experience with gas purifying houses, and with explosions, did not include anything with reference to electric lighting. I consider the use of electric lights in purifying houses eminently proper, but we have not put them in, although we produce and sell electric lighting: the opinion being presumably on the part of our directors that it was an unnecessary expense. Further than that I have nothing to say with regard to it.

MR. E. E. WITHERBY :—Without any question the wiring should be enclosed in interior conduits or iron pipes, which are insulated on the inside. Then no joints, or fuse, or branch-blocks of any kind must be allowed inside the room where there can be a possibility of an explosive mixture being present. The insulated wiring, with moisture-proof sockets, and switches outside the building, will effectually prevent any possible chance of explosion, even with the most dangerous explosive mixture, if the work is only done properly.

Mr. C. A. Learned (Meriden, Conn.):—Last year we put up a new purifying building, and, as we run both gas and electricity in our town, we wired the purifying house, and put our main switch and the fuse-boxes just outside the door. We put our wires in iron pipes outside and in wood mouldings built for the interior work. The bulbs are enclosed in what are called Newgard receptables, simply as an extra precaution. The receptacle is a kind of Mason jar with rubber casing on the top of it. We have had no trouble, and do not expect any.

Mr. E. J. Donahue:—I have noticed several installations of electric wiring in purifying houses. The interior was well done, but the switches were not located in what I would call a safe place. They were enclosed, in a box, and located on the outside wall of the purifying house, within a foot of the door. Turning on or off a switch makes a spark, and if an explosive mixture was flowing through the doorway at the same time the switch was turned on, it is possible that there would be an explosion. To make the installation perfectly safe, the switch should be located some distance from the house, say fifty feet.

The President:—Another question is:

How long is it economical to run a Lowe water-gas apparatus without cleaning the checkerbrick? Is it economical to let down the machines for twenty-four hours every week in order to burn out the carbon which has accumulated on the checkerbrick?

Will Mr. Norris answer this question?

Mr. Rollin Norris (Philadelphia):—I hesitate to give a categorical answer to a question of that kind. I believe in cleaning whenever there is a falling off in efficiency sufficient to justify the expense of cleaning.

As far as the burning off is concerned—a good deal can be done in the way of postponing the cleaning by occasionally burning off the carbon by the air blast. Of course it is objectionable to burn off the carbon when the set is in constant operation by simply stopping for an hour or so, burning off and then going ahead and making gas. That completely disarranges the temperatures in the fixing chambers, and it takes some time to get things back into the normal state.

Mr. J. E. Nute (Fall River, Mass.):—I think Mr. Norris has covered the ground entirely. The intervals in which it seems advisable to clean the checkerbrick depend altogether upon the manner in which the machine has been running. A clean machine, if improperly run, very soon gets clogged up and requires re-cleaning or burning out. If the machine has been run properly it will last a considerable time without burning out, but just how long I am not prepared to say. I generally run a machine three months without cleaning, where it is run almost continuously. I do not know what the usual practice is in this regard. I think it is safe to say that it will run that length of time at any rate.

Mr. H. K. Morrison (Concord, N. H.):—My experience has recently been with a machine run intermittently; this requires more frequent cleaning. It is an easy matter to clog up a machine even at the very start. It depends upon how the machine is run whether you have to clean it once a week, or only once in six months.

The President:—We will now listen to Mr. Littlehales' paper. "Retort Ovens as Producers of Illuminating Gas."

Mr. T. Littlehales (Syracuse, N. Y.):—Before reading my paper I would mention that the two tables which appear in the paper were intended to figure at the end, as an appendix. They are simply details of figures which will enable you to check up my figures.

(For Paper see Appendix page xlvii)

The President:—You have heard Mr. Littlehales' very comprehensive paper. Who is desirous of discussing it?

Mr. C. G. Atwater (New York City):—I want to express my gratification at hearing so hearty an endorsement of the retort oven as a gas producer from a gas engineer of Mr. Littlehales' wide experience, and particularly to welcome the nomenclature he uses in terming them "retort ovens." It seems to me that the coke oven, in turning from its wasteful courses in the wild places of Pennsylvania to take up a better and more economical mode of life within the confines of civilization, ought to adopt a name that does not carry with it the recollection of blinding smoke and reddening skies. The term "retort ovens" may not be entirely new, but it is good. But I hardly think that Mr. Littlehales' closing statement is quite as hopeful as the array of facts he cites will justify. He says, in effect, that where there is a market for a first-class foundry coke at good prices, the retort oven will produce gas at a lower price than the gas retort. This is limiting the retort oven to a very small field outside of the furnace coke precincts. That good coke, sufficient for all the requirements of the modern blast furnace is made in retort ovens, has, I think, been pretty fairly demonstrated. Sydney, Dunbar, Johnstown, Sharon, Wheeling, Glassport, and the new plants being built by the United Gas & Coke Company for the Lackawanna Iron Company at Buffalo and Lebanon, and for the Maryland Steel Company at Sparrows Point may be fairly said to have proved that proposition, in spite of the non-adherence of the United States Steel Corporation. But it is not the making of blast furnace coke that interests the members of the American Gas Light Association. There are relatively few locations where retort ovens making blast furnace coke can be placed in which their full gas capacity can find satisfactory outlet, except where a large part is used in steel heating furnaces or under boilers, which are uses no coal gas plant can dream of supplying in these days. Nor, I hope, is the field limited by the market for a foundry coke. The demand is regular and the prices satisfactory, but the volume of business is not sufficient to make the industry of importance by itself, nor would it affect the gas field one way or another. But it is the introduction of coke in domestic use, railroads, and industrial establishments throughout the cities and the towns of the United States, wherever soft coal is now used, and in some places where anthracite coal is employed, that will herald the appearance of the retort oven in the gas field. That is the gist of the problem. When the soft coal that is now shipped into nearly every city in the Union is required to pay the toll of its almost useless and always smoky hydrocarbons by passing through a retort oven, before it reaches the furnaces where it is to be used, then the gas making side of the retort oven will have come into its own. And that this hope is not without justification we can judge from the success of the Everett Works in disposing of about 1200 tons of coke a day continuously for over a year past. That this success is not regarded by experienced gas men as ephemeral is shown by the plant almost exclusively for theirown use, built for the Hamilton Otto Coke Company, and the one in course of construction at Camden, for the South Jersey Gas, Electric & Traction Company.

And therefore I will ask Mr. Littlehales' consent to the following proposition: In the average town where there exists a minimum daily demand for the surplus gas from at least 50 retort ovens, and where the community already consumes enough solid fuel to give the equivalent coke a fair chance for introduction on its merits, there retort ovens will justify their existence.

Mr. F. Egner (Norfolk, Va.):—I have read Mr. Littlehales' paper with much interest, and when I first saw it I was sure that he would give us something that was worthy the high standing of this Association. That by-product coke or retort ovens, as Mr. Littlehales designates them will receive careful consideration, cannot be doubted, they having already attracted the attention of notable men in the gas business. This was shown me by a conversation which I had with Mr. Goodwin Newton, the President of the Imperial Continental Gas Association of London, some years ago, who at that early date seemed to favor them. I think the whole question may be considered in connection with the careful study of another one: Will it pay? I am willing to take a great deal that Mr. Littlehales says on his word, because I know that he has been a careful manager and is a thorough gas engineer; and therefore when he makes a statement on any subject, and states he has given it his careful consideration, as he has in this paper, I will take it for granted there can scarcely be any doubt about it at all—even if there might be a difference of opinion. But in going over his figures, I find that there are some statements made which may easily be questioned with him. Take for instance his statement as to the cost of carbonizing coal. He states that a ton of coal is carbonized in these coke ovens for twenty cents and less. That is about the substance of his statement, as I understood the paper. He has stated that in gas works the cost of carbonizing per ton would be about ninety-five cents. I know that with ordinary horizontal retorts and with machine stoking, the cost for labor can be brought down to twenty-five cents per ton; while if inclined retorts are used it will go below twenty cents. So that retort ovens have not got so very much advantage of what we already have in the line of gas retorts, while as to the cost of the apparatus, the balance is entirely in favor of the inclined retort system, as I have shown in the columns of the American Gas Light Journal some months ago.

Mr. A. S. Miller (New York City):—When I first read this paper, I felt a good deal of consternation, for it seemed to me to be one of the worst indictments against the gas men that I ever read. It looked as if for years we had been doing without this wonderful improvement. It is true that a tremendous amount of gas is wasted close to where the coke is used. On looking over the pages we find that sixty-five per cent. of all the coke made in this country is used in Pennsylvania (including two other states, which use very little), and presumably a large proportion of this is used in blast furnaces. Mr. Littlehales makes this statement to show that we can take the gas away from these points:

" Mr. Shelton has given an excellent practical demonstration and proof of the fact that ordinary illuminating gas can be economically and satisfactorily carried under high pressures for long distances."

Mr. Shelton may have given such a demonstration, but he has never given it to this or to any other Association in this country. He has given us a good deal of information how it is being done, but he has not yet given us any practical demonstration or proof that it can be done economically and satisfactorily. He has never given us the figures to show what it cost him to handle this gas, or whether there is or is not a loss in illuminating power. He has stated that he never made any tests on the bar photometer, and therefore does not even know what the loss in illuminating power is, and does not even know yet what it costs him; or if he does know, he is not yet prepared to give us those figures.

As a matter of fact, how far could we carry the coal from the point where the coke is used in order to make gas? According to Mr. Littlehales there can be recovered 4,000 feet of gas per ton of coal. That is a high figure. It may have been reached in practice. I will assume that it has been. Let us suppose, for instance, that gas costs us forty cents per thousand cubic feet in the holder of our ordinary gas works. That would be $1.60 per ton. If we had to haul the coal down and the coke back, that amount would haul it about one hundred and eighty miles. How many cities could we reach within one hundred and eighty miles of the blast furnace. If we could sell all the coke in the cities, we could haul the coal a little over three hundred miles for $1.60. You can all judge whether you would have $1.60 or not for that purpose by the cost of your gas in the holder.

Mr. Atwater has spoken about making a market for coke where the gas is to be sold. That is an entirely different proposition from that which Mr. Littlehales has given us. Mr. Littlehales has told us that the gas people are losing opportunities in letting the gas go to waste. If we want to figure the proposition on Mr. Atwater's basis, the problem is different. Let us assume that we take Mr. Atwater's figures. He says that we must have gas consumption and hard fuel consumption equivalent to a capacity of fifty retort ovens. These ovens handle about six tons per day of twenty-four hours per oven which is three hundred tons of coal per day, which is equivalent to 1,200,000 cubic feet of gas per day. How many gas companies in this country could sell 1,200,000 feet of gas per day if they were to deduct from the selling price the total cost of the gas in the holder?

Mr. W. R. Addicks (Boston):—I think it goes without saying that there is more in this subject than appears on the surface; and more perhaps in coke ovens, and in their favor, perhaps, and more difficulty in the way of introducing and using them, than Mr. Littlehales has seen fit to point out. In reading the paper, and referring to the output of coke in the whole of Pennsylvania, as indicating the possibilities of saving all the gas, I could not help but think of the famous actor who impersonated a part in which the hero had an eye-wash which he proposed to dispose of in Africa, on the understanding that all the Africans had sore eyes and that there were "millions in it." You all probably remember what I refer to. I do not mean by quoting that to intimate that there is not something in coke ovens. On the contrary, I think there is something in coke ovens; but I do not think that they are going to displace all of our gas works in all of our cities.

I have a number of questions which I trust Mr. Littlehales will pardon me for asking; and of course I will not take exception if he declines to answer the questions. There has already been a gentleman who presented a paper here and who avoided answering some questions concerning it; and I presume that Mr. Littlehales has the same privilege. I want to point out one fact. We will take the output from the fifty ovens referred to by Mr. Atwater. As I understand it, the position taken by the coke oven people is that the ovens must run continuously. Therefore that output which the gentleman asked for is not the output which would naturally be in the minds of you gentlemen as the maximum, but it is the minimum output. In other words, it is the output of gas from those ovens on the smallest day of the year The maximum output of course would vary in different parts of the country. An engineer putting in these ovens must remember that he must have auxiliary works to supply that difference in output for the winter months; and the cost of his gas is not only the cost of that gas in coke ovens, but includes the additional cost of the auxiliary plant that he must have to take care of his business. I am referring now only to a gas business, and not to a coke business. Undoubtedly the coke oven could be placed and do the business on a coke basis only; but I am only speaking of those members of this Association who, as gas engineers, are contemplating their introduction and their recommendation to their own stockholders; and who would have to think of all these points in determining what could be done in their town, great or small.

As I said, I have some questions to ask Mr. Littlehales, and with his permission, I will enumerate them:

(1) Given the usual per cent. of sulphur in a good American coal, how many grains of fixed sulphur are there in one hundred cubic feet of gas before purification, in Mr. Littlehales' process? I am referring now to such gas as you would use for illuminating purposes. Some cities have a limit to the number of grains of sulphur permitted by law per hundred feet of gas.

(2) How many grains of fixed sulphur are in the gas, when using coal having a large proportion of sulphur, as compared with good American coal?

(3) Referring to the statement that 4,000 feet of surplus gas would be obtained practically from all the coal that was coked in the State of Pennsylvania, as I understand the paper,—and referring to that, and without any classification as to the quality of the coal—I ask the question: How was the number of feet of surplus gas in any place determined; and during what period of days; and if, during this period of observation, there was any change in the heats in the oven?

(4) At what time of the year, and in what part of the country were these observations made?

(5) I would also ask Mr. Littlehales if he would wish us to understand that the percentage of surplus gas is a constant, independent of the quality of the coal; and that it is independent of volatile constituents and independent of the heat unit value in the total gas.

(6) I would also like to ask him how many hours the ovens ran on surplus gas, and how many hours on gas for heating the ovens, when he is obtaining four thousand feet of surplus gas?

(7) And, I think it is a fair question to ask what would be the effect on the price of residuals if all the gas works he mentions were to set up coke ovens?

(8) And, in connection with that, I would like to ask how many pounds of coke, how many gallons of tar, and how many pounds of sulphate of ammonia would he have for sale for each ten thousand cubic feet of illuminating gas sold.

(9) And, apropos of the question of making different grades of coke, I would like to ask what effect on the surplus gas has the making of a hard coke as compared with the making of a comparatively soft coke. I mean by "soft coke" that the coke would be harder than gas coke in any case, and I am referring now to making the very hard metallurgical coke and am asking whether that would affect the amount of surplus gas.

Mr. Littlehales has placed himself so firmly upon the platform of coke ovens that I think it is perfectly fair to this Association, and fair to the members, to ask these questions. It may be that many of them may have some reference to this particular process, that he would not care to state; if so, I shall cheerfully withdraw such questions.

MR. C. H. NETTLETON (Derby, Conn.):—In listening to this paper, and also in conversation with Mr. Littlehales, it has probably seemed to me that he was enthusiastic on the subject of coke ovens, and to some extent that his opinions were influenced by his enthusiasm, but those of us who have known Mr. Littlehales, as many of us have, for twenty-five or thirty years, know that he always expresses what he believes. He has gone into this subject carefully, as I know from what he has told me, and I am satisfied that he is not misrepresenting in any particular his position in the matter. I am sure that he firmly believes just what has been stated in this paper. It may be that he is mistaken in some respects. It does seem to me that the question resolves itself into this—whether the coke can be sold. Many of us have had the pleasure of going through the coke works at Everett, and the statement has been freely made that the works are primarily a coke works, and that the residuals in the order of value are: tar, ammonia and gas—the gas being the least valuable. Now, if from 2,000 lbs. of coal, 1,420 lbs. of coke can be made, and if that 1,420 lbs. of coke can be sold for the value of a ton of bituminous coal—say $3.50 or $4.00, and if the coke can be sold readily, and if the other residuals will sell at the prices that ruled a year ago (not at present prices), under those conditions the question would appear to me in a much more favorable light than it does to-day. But with most of us coke must be sold for household purposes, and the question is can this be done at prices that will pay? Personally I very much doubt it; and with the uncertainty as to the value of tar and ammonia in the future, the system does not appeal to me as a particularly attractive method of making gas.

Mr. W. W. Seymour (Tacoma, Wash.):—On page lxix speaking of gas works of even moderate size, Mr. Littlefield says that with retort ovens and turning out a first class foundry coke for which there is a large demand at good prices substantial profits can be made. I would like to have him designate a little more particularly what he calls "gas works of moderate size." And also, how many ovens would be the smallest number which could be worked economically; and what is the cost of making those. The number of fifty has been mentioned. Is that the smallest number that can be worked economically? And what would it cost to put those in?

Mr. A. S. Miller (New York City):—I overlooked one point in my previous remarks. It is the matter of the separation of gases. Mr. Littlehales says that it would be of no advantage in a retort. I would like to state that so far as I can see, that is the only reason they are not separated in the case of the retort. There is no reason why they should not be separated, as he has indicated. I consider that a distinct disadvantage in this process which we have under consideration.

Mr. M. S. Greenough (Cleveland):—I have no prejudice against the use of gas made in this way, or in any other way in which I think we can make money. When the time comes for the erection of a gas works with which I have anything to do, I would be ashamed not to put in retort ovens if I could see an advantage in making the gas in that way. I do not want to put myself on record at this present moment as controverting the position taken by Mr. Littlehales as to the greater economy of these ovens, but that economy as yet has certainly not been proven. I do not think the American Gas Light Association should suffer such positive statements to go by without protesting against them—unless they agree with what is said.

Now, taking what Mr. Littlehales says in the first place,—that he can handle a ton of coal for thirty cents. He says it can be done for less money; but we will say thirty cents. And he says that a ton of coal can be handled for ninety cents in the ordinary methods. In the one case you get ten thousand feet where the cost would be nine cents per 1,000 for labor; and in the other case you get 4,000 feet to sell which would cost you nearly as much per 1,000. Now the real question is, what do you get out of a ton of coal to sell? You have got your ton of coal in your works. In the one case you have gained, say fifty or sixty cents in labor, and you have 400 or 500 lbs. more of coke to sell than you had before. 500 lbs. of coke will net, say 50 cents. You have that to sell; and you have saved on the labor account perhaps 60 cents per ton. That is your saving. There you are.

Mr. Littlehales talks about making eight gallons of tar per ton. I average fifteen gallons; and even with regenerative benches I sell fourteen. So that he is out six gallons of tar. You can estimate for yourself what it is worth.

He figures on fifteen pounds of sulphate of ammonia. That is four pounds of free ammonia. He ought to get more than that.

Mr. T. Littlehales:—Certainly.

Mr. M. S. Greenough:—I sell over five pounds. Then I have practically 6,000 feet more gas to sell than he does.

Now, it does seem to me that the balance, as far as he shows it, is not in favor of the coke oven. He says that he has other figures which he is willing to show to the private investigator. As a member of the American Gas Light Association, before I assent to the statements that that is to be the future method of gas making, I want the figures of that kind shown by somebody as to the profitable running of one of those works. Reference has been made to the gas-coke plant at Everett. What does the financial market say about that plant? What are its bonds and stocks selling for? Are they worth what they have put on the market for? Again, there is the Glassport Works. Has that Company paid a dividend? Is the Glassport coke satisfactory? Can you sell coke out of those retort ovens in the market for domestic purposes? Can the coke be sold as readily as I can sell it from my own gas retort? I say, no, because I run up against it all the time. Ton for ton the porous gas retort coke is the better coke of the two for domestic work.

I have nothing to say against retort ovens in their own departments. I do not mean for a moment to suggest that they are not a valuable adjunct to a blast furnace, or in any large iron works in which they see fit to make their own coke. I do not wish to repeat anything against the quality of the coke. I am simply referring to the manufacture of gas from those ovens. It is not impossible that I may be in error; but as for admitting that it is proven, or is beginning to be received as proven, that this is the best way for a gas company to build new gas works—I do not admit it for a minute.

Mr. R. M. Searle (Mount Vernon, N. Y.):—This paper would not only fill gas men with consternation, but it would also fill the producers of many of our nitrogenous fertilizers with consternation. Assuming a production of 16 lbs. of sulphate of ammonia per ton of coal and that all the ammonia residual from the coal used in the coke ovens in 1890 was converted to sulphate, then 30,219,343 tons would give us approximately 480,000,000 lbs. sulphate of ammonia to be disposed of in competition with other nitrogenous fertilizers. I know the nitrogenous fertilizer people are not going to lie down and let us get $50 per ton for sulphate. If we attempt to fill the market with this amount of fertilizer they would make us bring the price down to $15 or $20 per ton, and they would then sell their product at a profit. Therefore I do not see how we can count on getting $50 per ton for sulphate of ammonia if all the ammonia recovered from coal coked in this country is converted into sulphate of ammonia.

Mr. T. Littlehales (Syracuse, N. Y.):—I must say that you have treated me very kindly and I appreciate it highly. I knew that I was in all fairness justly a target; and if I had received even hotter shot I should still consider that I was fairly a mark for it. I thank you all for the very moderate way in which you have criticised my position.

If I do not give the answers to the questions in the order in which they were put, will you kindly pardon me? My hearing not being very good, I did not fully get all the questions, but I will try to get through them as well as I can.

I am asked about the limitation of the field to the oven—and as to what size of place the oven is applicable. That will depend largely upon the character of the locality. I have said in my paper that in localities where there is a demand for foundry coke, or coke for other purposes, the oven can be made a success; and it can be made a success on a much smaller scale than you would suppose. When you bear it in mind that there are localities in which the foundries, furnaces, etc., use ten times the coke that the gas company produces; and that the gas company's coke is absolutely unsuited for their requirements; that if the coke from the gas company would do the work, they could readily sell several times their present make; and that there are other localities where even smaller foundries and other users would take their production,—if you bear all these things in mind, the question about getting rid of the coke becomes unimportant; and many of you probably have already one or two foundries in your own town; for there are very few towns of moderate size in the country where they have not one or two foundries, or within a very short distance from the town. I am quite ready to concede the proposition of Mr. Atwater, and would go even further than that, and say that under the conditions he names, an installation of much smaller size than fifty ovens will justify its existence.

I look at it from this standpoint as a gas man, and the question comes to each of us, by what methods can we best earn dividends on the capital entrusted to us? I care not whether it is by making water gas, or by making coal gas, or whether these dividends are to be earned by coke making. If I could earn a larger percentage on the money invested, a larger return on the capital entrusted to me by changing the methods of manufacture from one basis to another, I will make that change. That is the standpoint from which I am looking at and considering this question. In reference to the quantities of tar and ammonia produced in the ovens, as raised by Mr. Greenough, I purposely understated it, so as to enable comparisons to be made on a perfectly safe basis, from the oven side of the question. As a matter of fact, we are actually obtaining at least as much ammonia as the best gas works practice; but we do not make as much tar; and we are not sorry to have the tar more conveniently and profitably disposed of in the distillation.

The cost of carbonizing labor has been referrred to. You all know the methods by which the British Gas Companies' accounts are kept. A pretty rigid analysis is made, and the results are put in a complete and concise form, as you will find in Field's analysis. The aggregate of thirty-five companies there represented shows a cost of sixty-nine cents per net ton of coal. The rates of wages in Great Britain are very much lower than in the United States. Therefore I assume that on the higher rate of wages paid here about ninety-five cents in the average gas works would be a fair figure. I know that in some few cases, some exceptionally well managed works, where everything is complete, the cost is a little under ninety-five cents; but I also know that in other works the price goes considerably higher than that. I think when you look over it more carefully, you will find that ninety-five cents per ton of coal carbonized is not far out of the way.

As to Mr. Miller's remarks I cannot regard it as any reflection on the gas engineers of the past or of the present, that, in their constant efforts to improve the methods of manufacture, so as to cheapen the product, they should occasionally strike on something that has not before had the showing it deserved. As to his remarks about Mr. Shelton's position on the distribution of gas, let me say that Mr. Shelton has read two papers before two different Associations. As I recall his statements, his words were distinctly to the effect that as far as loss of illuminating power was concerned, while they had made no photometric tests, none of those engaged in the operation could distinguish any difference with the eye. Of course that is only a crude method of determining the illumination; but a gas man who is accustomed to photometrical observations could come pretty nearly to an approximation. And, while I do not believe it is possible to deliver gas at any considerable distance without some loss, I know this—that in the City of London, in some parts the gas is conveyed a distance of probably sixteen miles; and that this has been done for the last twenty-five years; and that in some parts of London, the consumer is sixteen or seventeen miles from the works. At the South Metropolitan Station they do the same thing. True, some of them have pumping stations on the line to relieve the pressure—much like the system in use with oil pipe lines, but that gas can be, and is being carried long distances is beyond question. And this has been done for twenty-five years. That there may be a little loss is undoubtedly true, but that loss can be provided for; and it is not an expensive matter to make provision for.

I am sorry I cannot answer some of Mr. Addicks' questions; but I will answer his general proposition in this way, that as far as the sulphur is concerned, there will be practically no difference in the sulphurous condition of the gas in either the retort or coke ovens, when made from the same coal. That is to say, if you take the same coal and carbonize it in ovens or in retorts, the sulphurous condition and constituents of the gas will be practically alike. Of course, I am not comparing a poor coal used in the ovens, and asserting that with poor coal used in ovens, you will make as much gas, or as rich gas as you will make in the retort. But I do say that there are certain conditions where you can with advantage use a poorer coal in ovens than you would be justified in using in the gas retort system, because in the oven system your coke has so much higher value than it has from your retort, that that factor has to be taken into consideration.

Another question was raised as to the use of the coke oven requiring an auxiliary plant. It was one of the difficulties suggested to my own mind at first, as having a lack of elasticity; but that was before I knew how much elasticity there was to the oven system. There is a great deal more elasticity about it than you would suppose. The ovens can just as well be heated by producer gas as they can be by gas from the retorts, and the whole of the gas that is made in the oven can be taken for lighting. And this can be done economically. There may possibly not be sufficient elasticity in the installation of ovens to prevent the use of water gas plants for heavier requirements; but there are several means by which it can be done, and the difficulties be satisfactorily overcome. But the ovens can just as well be heated and are being heated to-day in some places, by the producer gas; and heated economically; and that gives a very much higher amount of elasticity to the gas making capacity.

The separation of the gases has been referred to. I repeat that the separation of gases would be of no advantage in the retort system, because we are gas makers and gas is practically the only consideration. But in the oven system there is another very important element coming in. There it is not all gas. The coke value is a very high one; and you have to balance the one against the other.

Mr. Searle takes up the matter of the price of ammonia and tells how it is going to tumble down the price; and he refers to fertilizers, as if the fertilizing branch were the only one to create a demand for ammonia. Cold storage has only comparatively recently been introduced; it has not yet found its bearing by a long way. Cold storage creates a very large demand for ammonia; so do many branches of manufacture, and there are other things which create a demand for ammonia. So I do not think that there is any need of worrying about the market for that article.

As many of you are aware within the last few years a great stimulus has been given to the use of tar by the tar-macadam road making. I know of a little town where upwards of twenty years ago I myself put down the first bit of tar-macadam road which was probably built on this continent Boards of Aldermen came down from time to time to look at it, and the only question was, "Would it last?" After it had stood without a cent of cost for repairs for fifteen years they came to the conclusion that it would last. It has now been adopted as the method of road building for that town and carried along to such an extent that, in that town alone there is used, as nearly as I can get at it, about twice the amount of tar that the gas company in that locality produces. The city to which I have referred is Hamilton, Ontario, Canada, with which I was formerly connected. The Gas Company there has had no difficulty in selling its tar and I am certain that in other places where that road is introduced, it may reasonably be expected that all the tar that can be produced will find a ready market. That deals with the tar and ammonia questions.

Now, coming back to the coke again. The thing has been tested over and over again. One of the greatest desiderata in coke for foundry purposes is that it must be of a dense character, and incapable of being crushed by the weight of the iron in the furnaces. You can easily see why coke distilled under the weight of six feet of coal is going to be a denser coke than one under only twenty inches as in the Beehive ovens. If that is not self-evident, I do not know of anything that is. As a matter of fact, if you subjected the two to anything like a crushing strain test, you can demonstrate that, as it has been demonstrated over and over again.

What I want gas men to look at and consider is the problem of possible changing from the gas to the coke side of the question as the more important financial consideration.

MR. F. H. SHELTON (Philadelphia):—Four or five years ago I had the temerity to stand up at Old Point Comfort and suggest the proposition of the construction of a "Quadruplex" purifier; and after I sat down, if my recollection serves me rightly, Mr. Littlehales was the one who led the onslaught on my carcass. So I am able to appreciate somewhat his position to-day. Time has evened up a little bit conditions between us Taking Mr. Littlehales' kindly "tip" at that time, I never have ventured to build a "Quadruplex" purifier. I think I went a little too far in what I there suggested. In the multiplicity of bricks which have been thrown around here in the last hour, two or three came in my direction and hit me. I use my words advisedly when I say I do not care a continental personally so far as criticisms of high pressure distribution are concerned; but I do not want a false impression of the success of such workings to go out because of a failure to reply to the comments which have been made. It is true I have not gone with any great particularity into some details in the question of high pressure distribution; and it is entirely true and entirely correct that neither I nor any one else has yet proved that gas can be satisfactorily distributed under pressure at the distances that would be called for by Mr. Littlehales' general proposition. My general thoughts agree with those of Mr. Miller on this subject; but I do want to say for high pressure distribution of gas, that in the moderate way in which it has begun, as all such new departures do begin, it is an unqualified success. There have been eight or ten lines put in, and I think I have proved to those who are associated with me, at least that gas can be successfully carried a number of miles with little pipes under pressure of a number of pounds, where heretofore we have scarcely used more than a number of inches in large expensive pipes. I am not ready to-day to state that coke oven gas can be carried under pressure two hundred miles; but for short distance work, and I believe ultimately for considerable distances high pressure is all right; and I want to go on record as emphasizing that point, and to say that if any one will drift over to alleged slow Philadelphia they may pick up a few points of novelty in that neighborhood, and may get some information, which they are now perhaps too busy to pick up while selling their six million feet per capita, or something of that sort!

Mr. T. Littlehales:—I will say that when I referred to Mr. Shelton's remark I had no idea of *distributing* under high pressure. That was not my idea at all. It was simply this, supposing there was a generating plant a few miles distant, that the gas could be conveyed in bulk to a central point, and there distributed in the usual way. That is what I meant. If I gave any such an impression as that I purposed distributing it under high pressure, I wish to correct it.

Mr. F. Egner (Norfolk, Va.):—Mr. Littlehales has given us a most valuable paper. We all agree in that. Many members of the Association have shown their appreciation of it by staying away; but they have gone over to Everett to inspect the coke ovens there. They did not expect that Mr. Littlehales' paper would be read today. I wish to move a hearty vote of thanks to Mr. Littlehales for his valuable paper.

Mr. W. R. Addicks (Boston):—A moment ago I arose for the purpose of making the same motion which Mr. Egner has now made, but the President failed to recognize me. My purpose was to move a vote of thanks to Mr. Littlehales for his paper, and in connection with that I would like to call his attention to two papers or discussions that were given at the New England Association meeting last year and the year before. I would like particularly to call his attention to my annual address in 1900 to the New England Association.

I am very glad to see this matter come before this Association. I shall welcome the day when we shall have some actual figures by which presumably the members of the Association can judge for themselves, and adopt the method suggested if it is acceptable to their particular conditions.

I second Mr. Egner's motion of a vote of hearty thanks from the Association to Mr. Littlehales.

The motion was carried.

The President:—We will now pass to the paper by Mr. Charles F. Prichard, on "The Fuel Value of Residuals."

(For Paper see Appendix page lxxvii.)

THE PRESIDENT:—Mr. Prichard's paper is now before you. Owing to the shortness of time, it will be necessary to limit the debate, as we have one other paper and a short topic yet to be read. Will Mr. Sherman open the discussion?

MR. F. C. SHERMAN (New Haven, Conn.):—We have been using our oil gas tar under our retort furnaces for the last two or three years, with the following results: Our furnaces burn sixty-six bushels of coke in benches of 6's and we use three barrels, which is equal to one hundred and fifty gallons of oil gas tar in those benches. You can figure up its value at the different places by what you can get for your coke. Calling coke six cents per bushel, which we can get in our town, it makes the tar worth $1.32 per barrel to burn. Those are the practical results.

MR. C. H. NETTLETON (Derby, Conn.):—I have only a word to say, and that is to congratulate Mr. Prichard on the thoroughly practical paper which he has presented. There has always been more or less guess work as to the true value of residuals. This paper seems to me to demonstrate in both a theoretical and in a practical way their absolute value for fuel purposes and in preparing this paper Mr. Prichard has done a very great service to all of us who are in the gas business.

MR. ROLLIN NORRIS (Philadelphia):—I would like to ask Mr. Sherman how he burns the oil tar in his benches; and whether they are simple benches or regenerative.

MR. F. C. SHERMAN:—We put it in with a steam atomizer. It is a very simple apparatus.

MR. E. J. DONAHUE (Philadelphia):—Has Mr. Sherman a coke fire?

MR. F. C. SHERMAN:—We start out with a coke fire, but we do not use coke after we get it going. We do not put in coke again.

MR. E. J. DONAHUE:—Has Mr. Sherman any trouble in keeping the tar burning.

MR. F. C. SHERMAN:—There is no trouble at all in keeping it burning. We have some trouble with the smoke if the men do not open the valve.

MR. ROLLIN NORRIS:—How does Mr. Prichard define "breeze?" Does he call everything breeze that goes through a screen of a certain size? Is it screened and if so, what is the size of the mesh?

Mr. A. S. Miller (New York City) :—I do not know that I can add anything to what has been so thoroughly, completely and satisfactorily covered by Mr. Prichard. He states facts which are not discussable. As Mr. Nettleton says so well, we have guessed along for a number of years on this subject. We have experimented a little bit in our works, and these details prove that our results have not been so far wrong. I always had the idea and always figured that the tar was theoretically a little higher in heating power. I am glad to have these figures given me, because they indicate that the tar is lower in heating power than I had supposed. I feared that I was not doing good work, but these analyses show that we were doing very well.

Mr. E. J. Donahue :—I would ask Mr. Prichard with regard to smoke when burning tar. I note here that he shows a tar burner, and shows secondary air admitted to setting at the bridge wall. Has he at any time been troubled with smoke at the stack outlet, or is that a question of the regulation of the air going into the setting at the bridge-wall ?

Mr. F. Egner (Norfolk, Va.) :—Mr. Prichard's paper has appealed to me very strongly in the way he has put his figures. I want to supplement it by saying that I had some experience in the burning of tar, and that I have found that in firing benches a gallon of tar was equal to two-thirds of a bushel of coke. I burned the tar without any perceptible smoke.

Mr. W. C. Morris (Ravenswood, N. Y.) :—It is a surprise to me that anybody should expect to get smoke in burning tar. I see no good reason for it.

Mr. E. J. Donahue :—Of course we know that with extreme care we need have no smoke; I was wondering if in cases of ordinary working of Mr. Prichard's system there would be smoke coming out of the stack ?

Mr. R. E. Holmes (Winsted, Conn.) :—I would ask if there is any nicety of adjusting the flow of tar; or does it flow by specific gravity.

The President :—I am very sorry to shorten the discussion on this paper, but time forbids that it should continue much longer. If there are no further remarks, I will ask Mr. Prichard to reply to the questions.

Mr. C. F. Prichard (Lynn, Mass.) :—Replying to the question as to size of breeze, I will say that the screen which we put our coke through is the ordinary 12-tine tanner's fork. I cannot tell how close these tines are together, but the coke is very small. There are no pieces in it that are over three-eighths of an inch. The breeze used in these tests was really the refuse from our coke yard.

In regard to the smoke from tar, I will say that we have absolutely no trouble. We seldom see any smoke at the chimney top. The tar burns at the burner with a clear white flame, and without smoke.

As to the flow of tar: we simply have a small tank on top of the boiler, as we did in the old retort practice, and let the tar run down by gravity. The water-gas tar runs very nicely, and requires very little care. The coal-gas tar is thicker, and gives a little more trouble, but we very seldom have any stoppages due to it. The firemen like it very much because it relieves them of a great deal of work.

MR. C. H. NETTLETON:—I move a vote of thanks to Mr. Prichard for his valuable paper.

Carried.

THE PRESIDENT:—Next in order is the Short Topic by Mr. Walton Forstall entitled "A Comparison of Standards for Cast Iron Pipe and Specials."

A COMPARISON OF STANDARDS FOR CAST IRON PIPE AND SPECIALS.

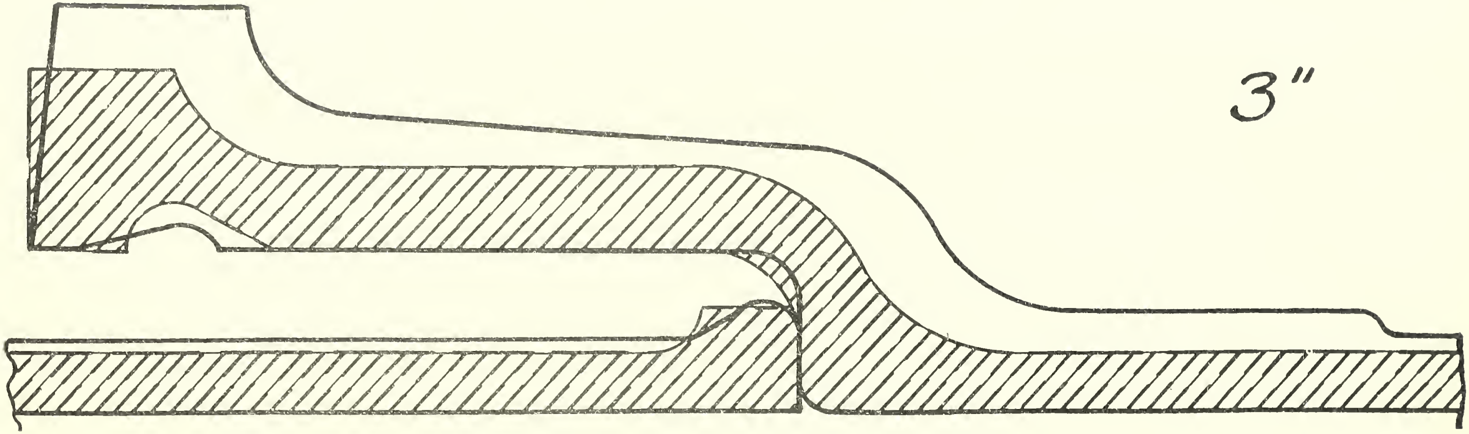
What follows is written in reply to the letter of the Secretary of this Association under date of February 27, 1901, asking whether the standards of the Association adopted in 1898 were approved of and would be used, and if not, what suggestions could be made looking to the improvement of these standards.

GENERAL DIFFERENCES.—The writer proposes here to discuss the differences between the standards of the Association and those now in use by the United Gas Improvement Company.

For simplicity we will hereafter call the former the "A" standards and the latter the "B" standards. Should any one desire to have his pipe and specials made by the "A" system, the only data, as far as the writer knows, to which he could refer the manufacturer, are contained on pages 77 to 91 inclusive, of Volume 15, of the Association Proceedings. The "B" system is shown in a handbook of 73 pages printed in 1900 by the United Gas Improvement Company, entitled "Specifications for Cast Iron Pipe and Special Castings." Now if the idea of the Association in presenting its standards was that they should be used as far as they went, and for specials not shown, the members should design for themselves or take what the manufacturers offered, then the criticisms which follow do not hold. But, if it was thought that in the pages of the Proceedings mentioned above, would be found all the specials required for gas work, then the writer believes it is easy to show incompleteness in the "A" standards, and this he will proceed to do in discussing the various classes of specials. For convenience of reference, the specials will be taken up in the order in which they are found in the Proceedings.

BELL AND SPIGOT DETAILS.—The cuts show very clearly, on full scale, the differences in bells and spigots of the two systems; the hatched sections, representing the "A" standards and the plain sections the "B" standards. As will be seen at once the "B" system provides for three larger sizes than that of the "A," and certainly any changes made by the Association should provide for standards up to 48″; the sizes added to the present ones being 36″, 42″ and 48″. The 40″ shown is peculiar to Philadelphia, pipe of that size having been laid by the Bureau of Gas, but the writer considers it an odd size and not to be recommended for use.

The first impression obtained from looking at the cuts, is that for sizes from 3″ to 8″ inclusive, the "B" sections are much heavier than the "A". The extra thickness of the pipe just back of the bell is in accordance with good foundry practice, and lessens the liability of "checking" at this point. The whole idea has been to provide so much metal at the bells that the chances of cracked bells due to caulking or any other strain, would be reduced to a minimum, and with our present practice of using heavy pipe, as for instance, 30 pounds to the foot for 6″, it would seem but consistent to be sure of the strength of the bell. This is especially true in regard to the 3″ and 4″ sizes, although it is to be hoped that practically no 3″ is ever put underground, except for repair work.



Comparison of Bell and Spigot Standards.

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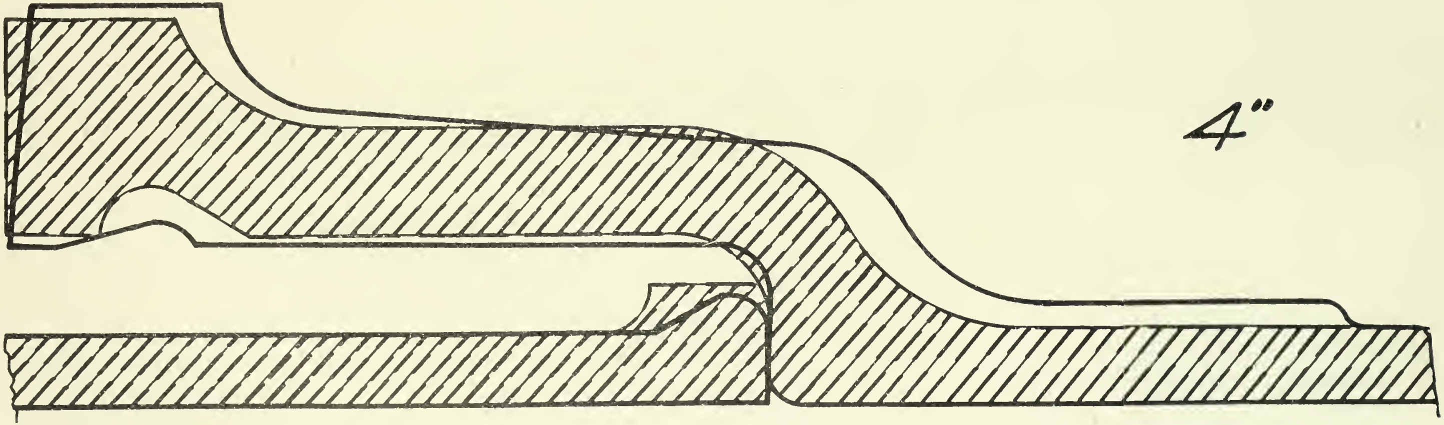

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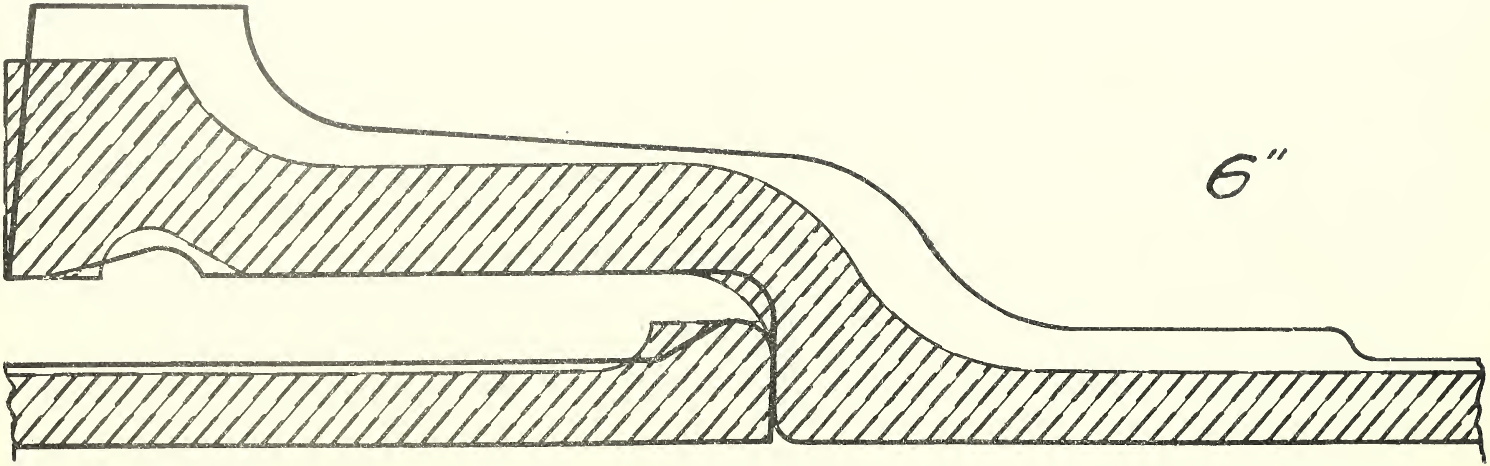

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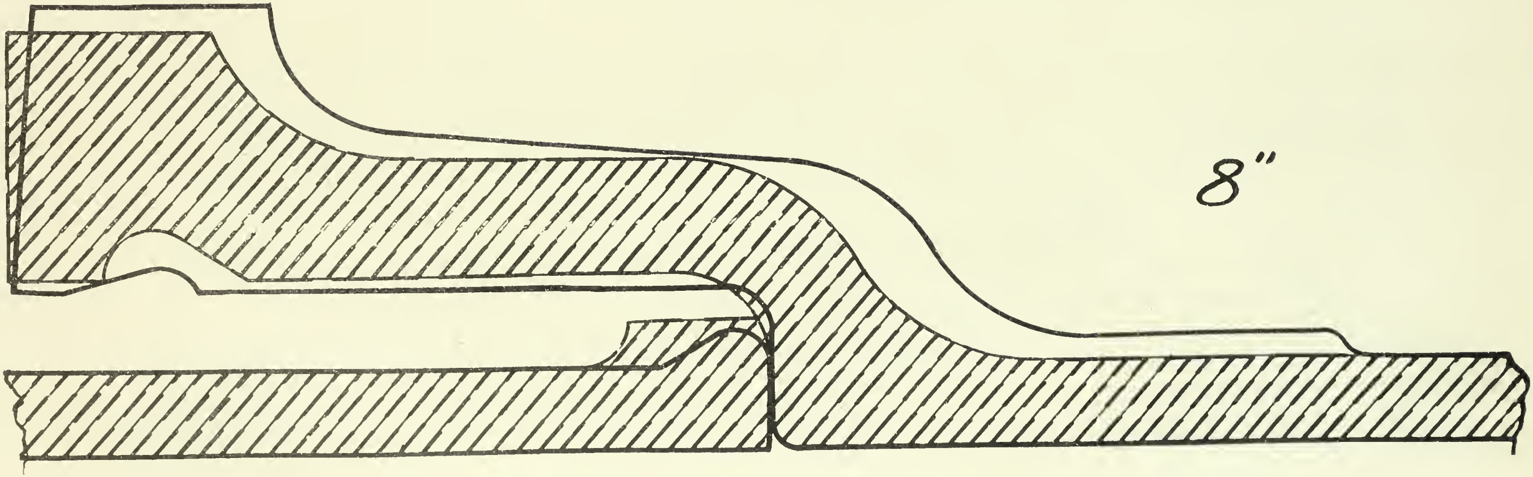

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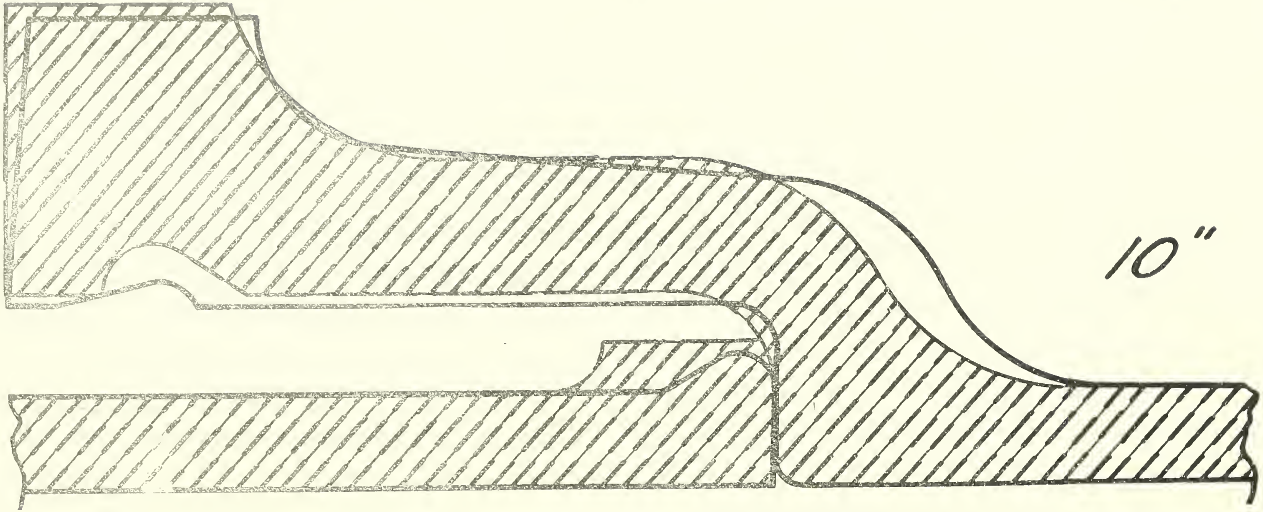

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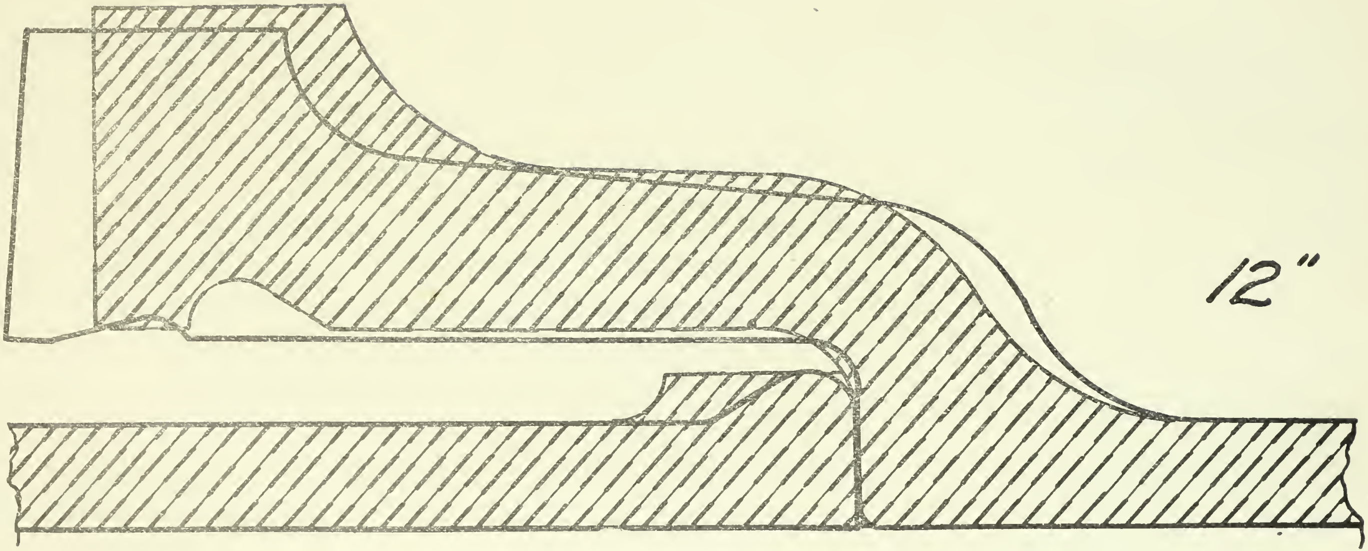

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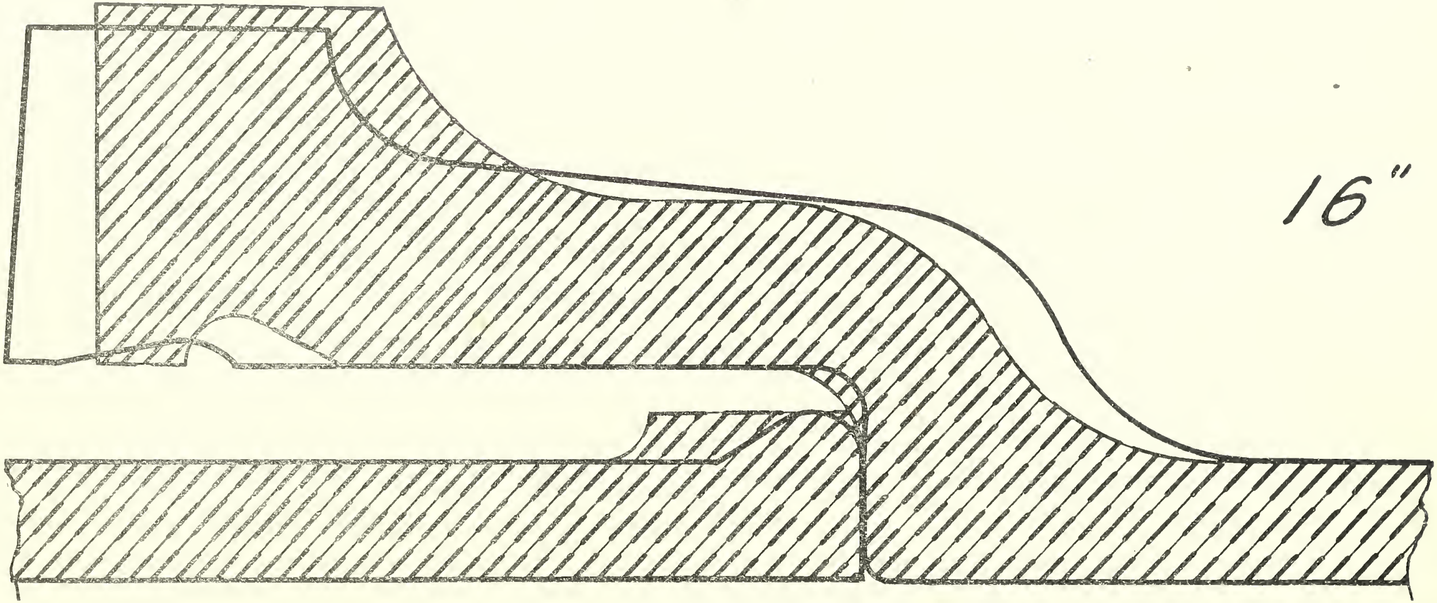

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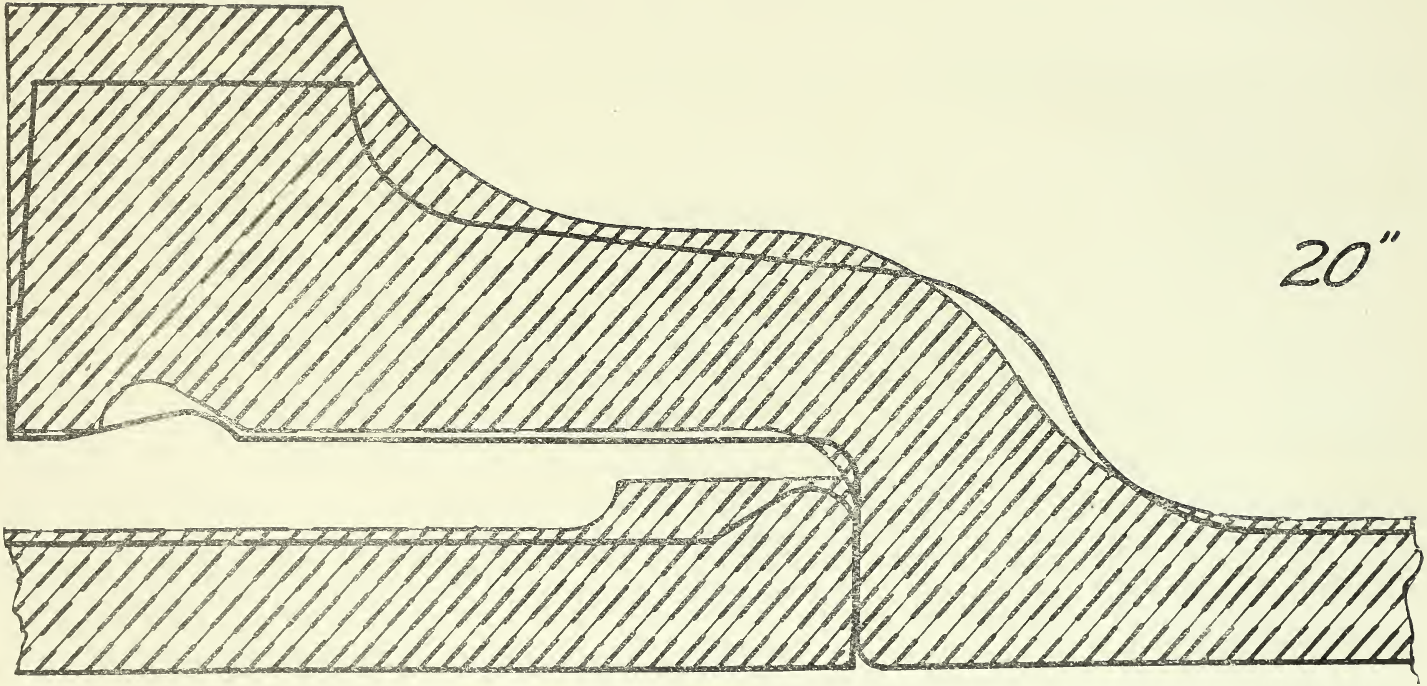

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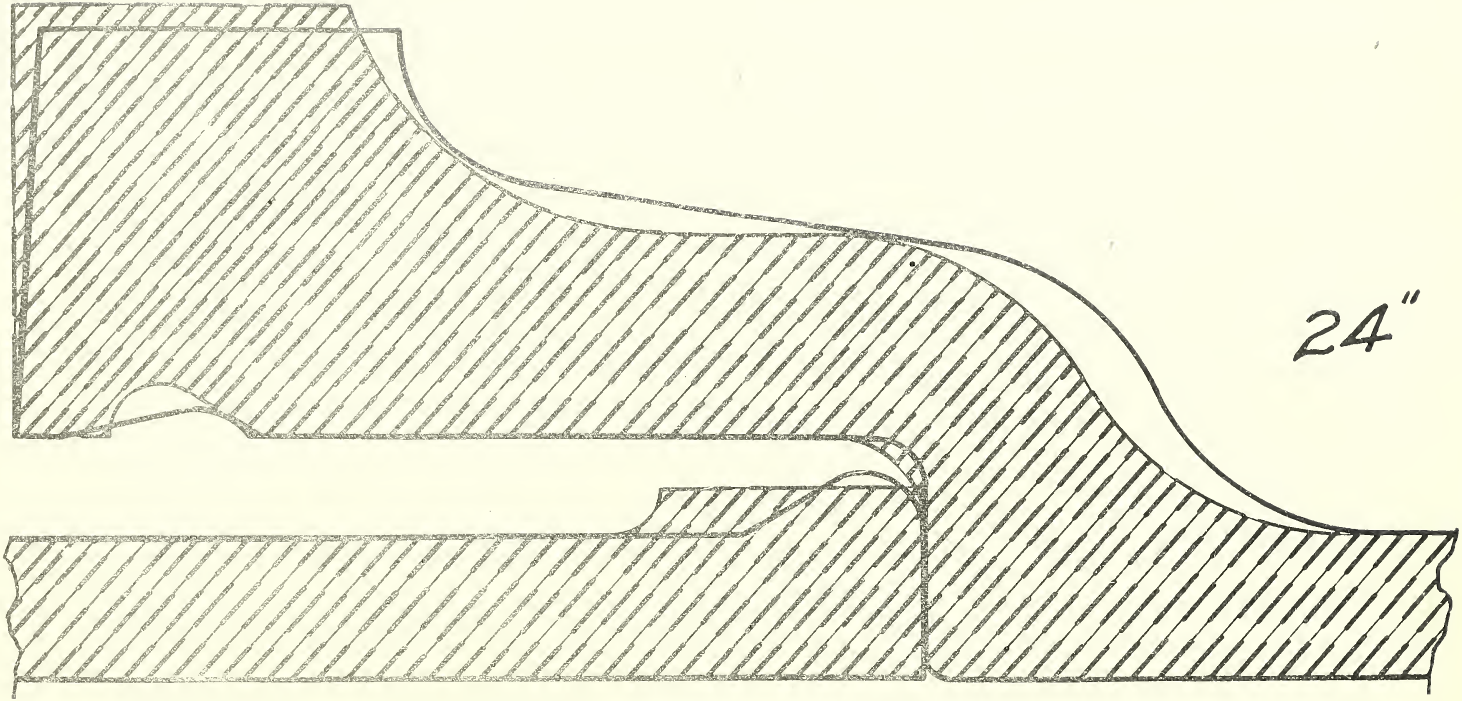

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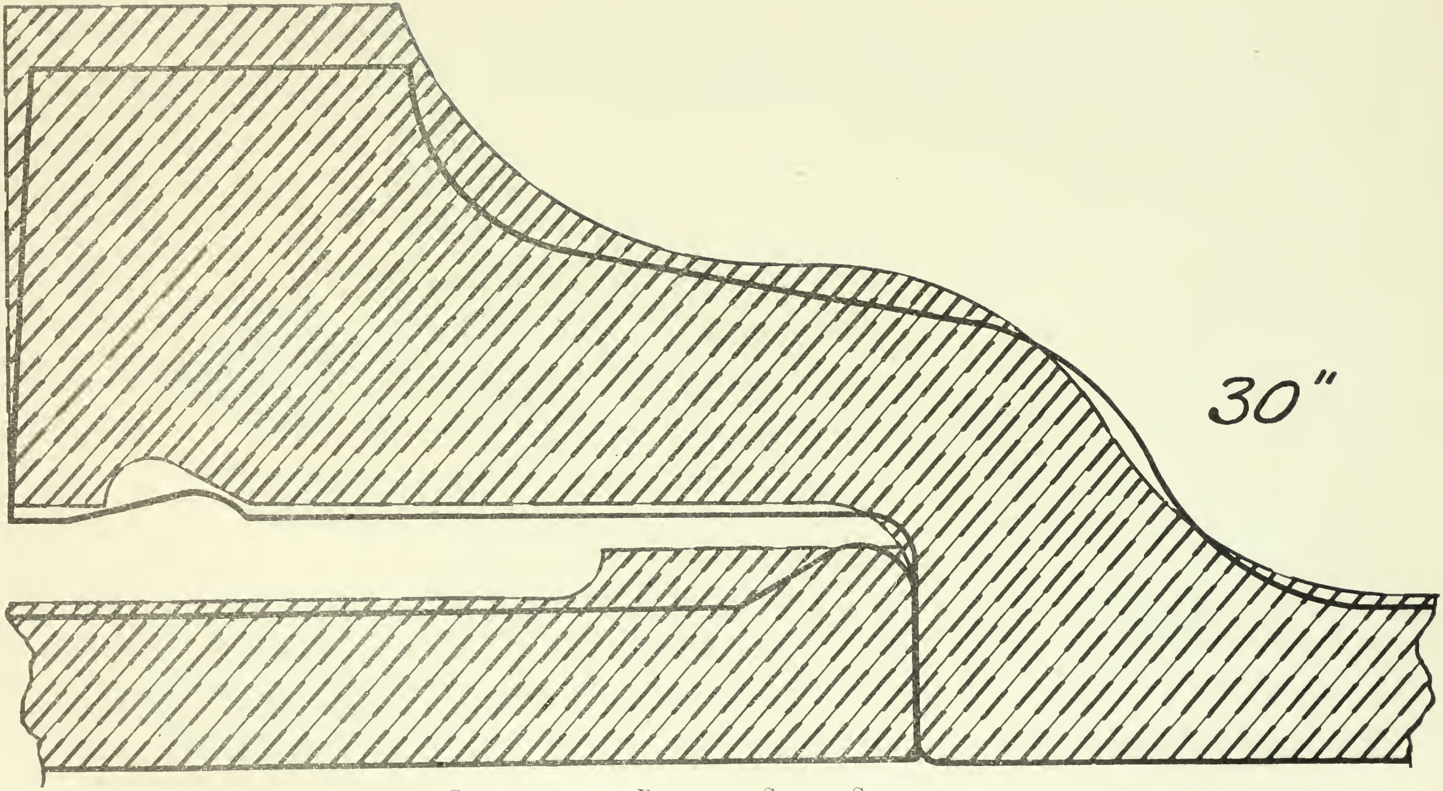

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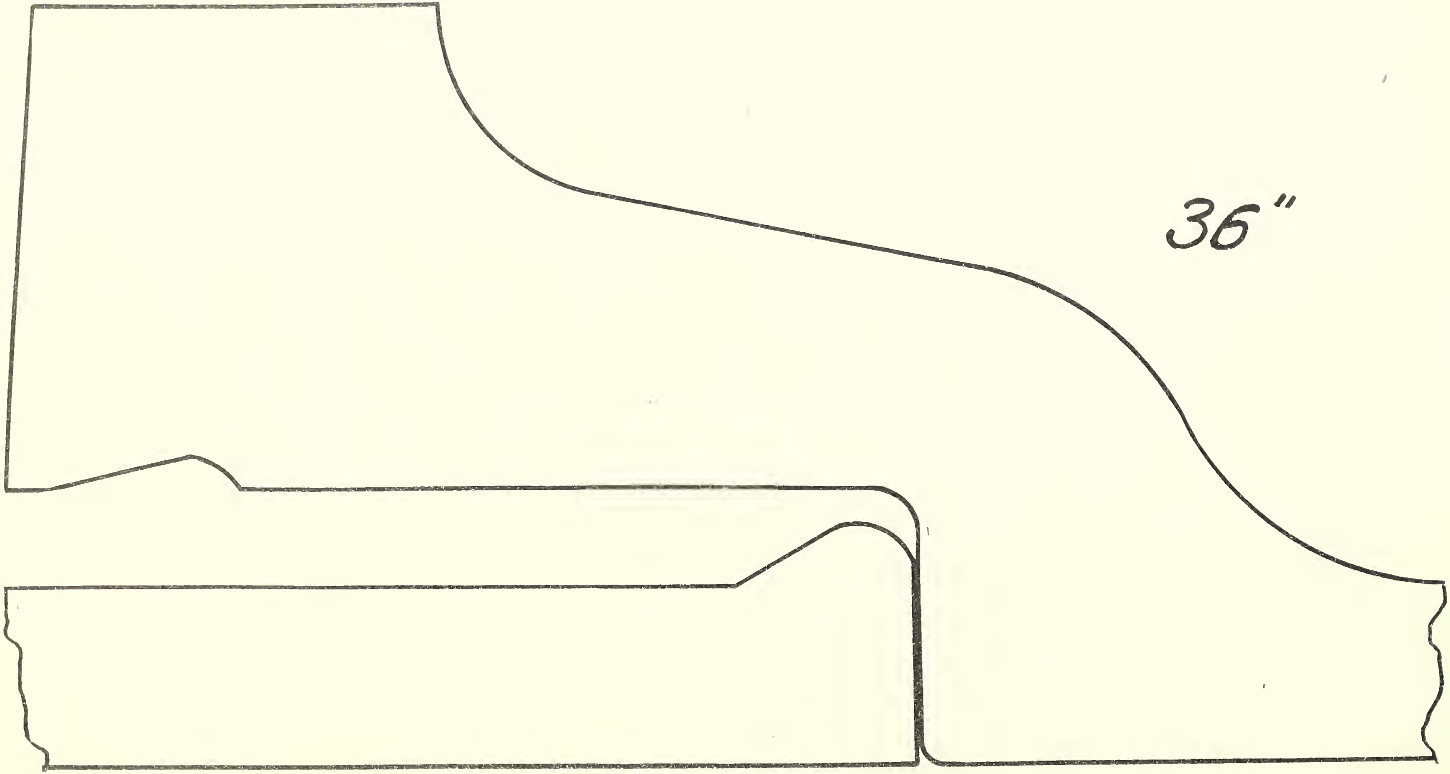

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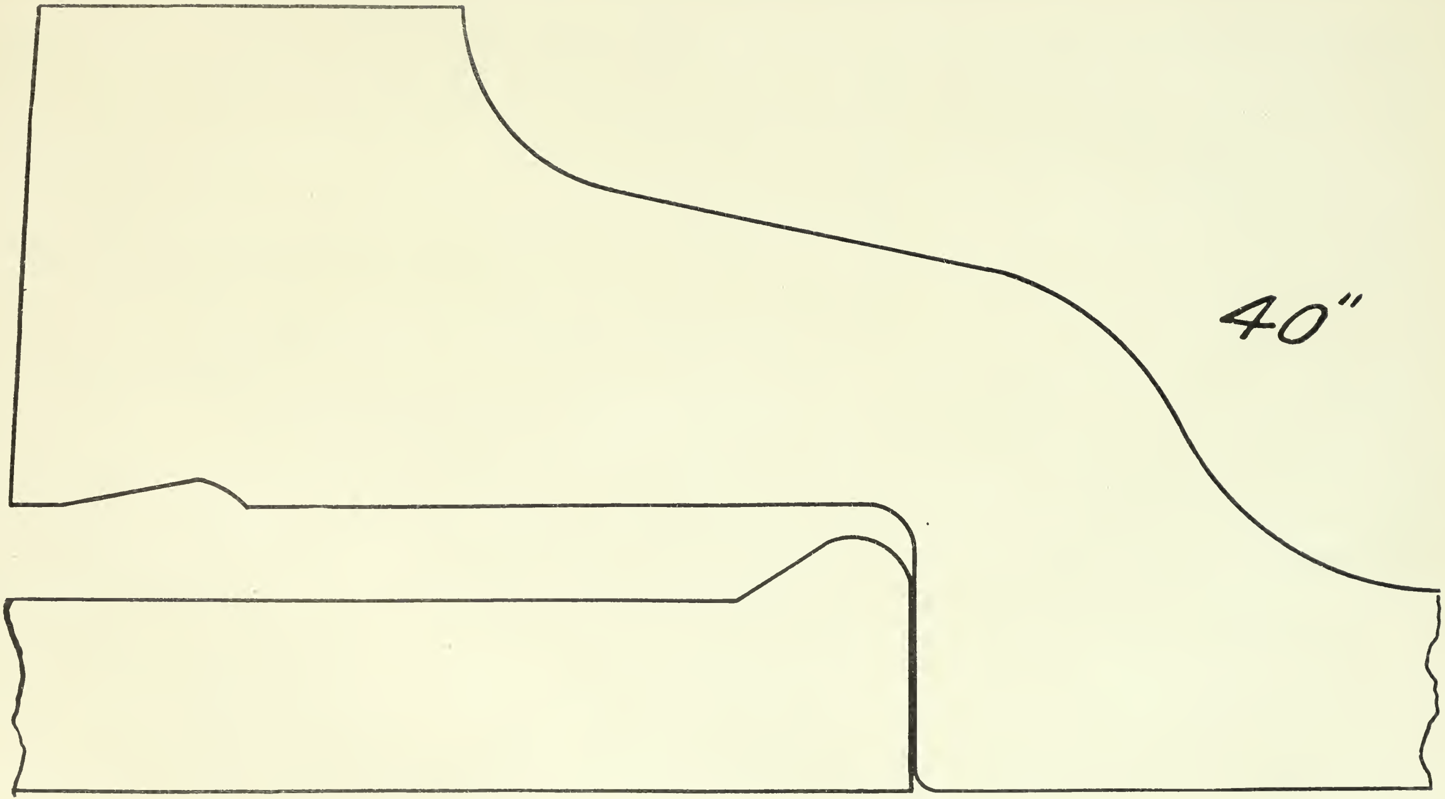

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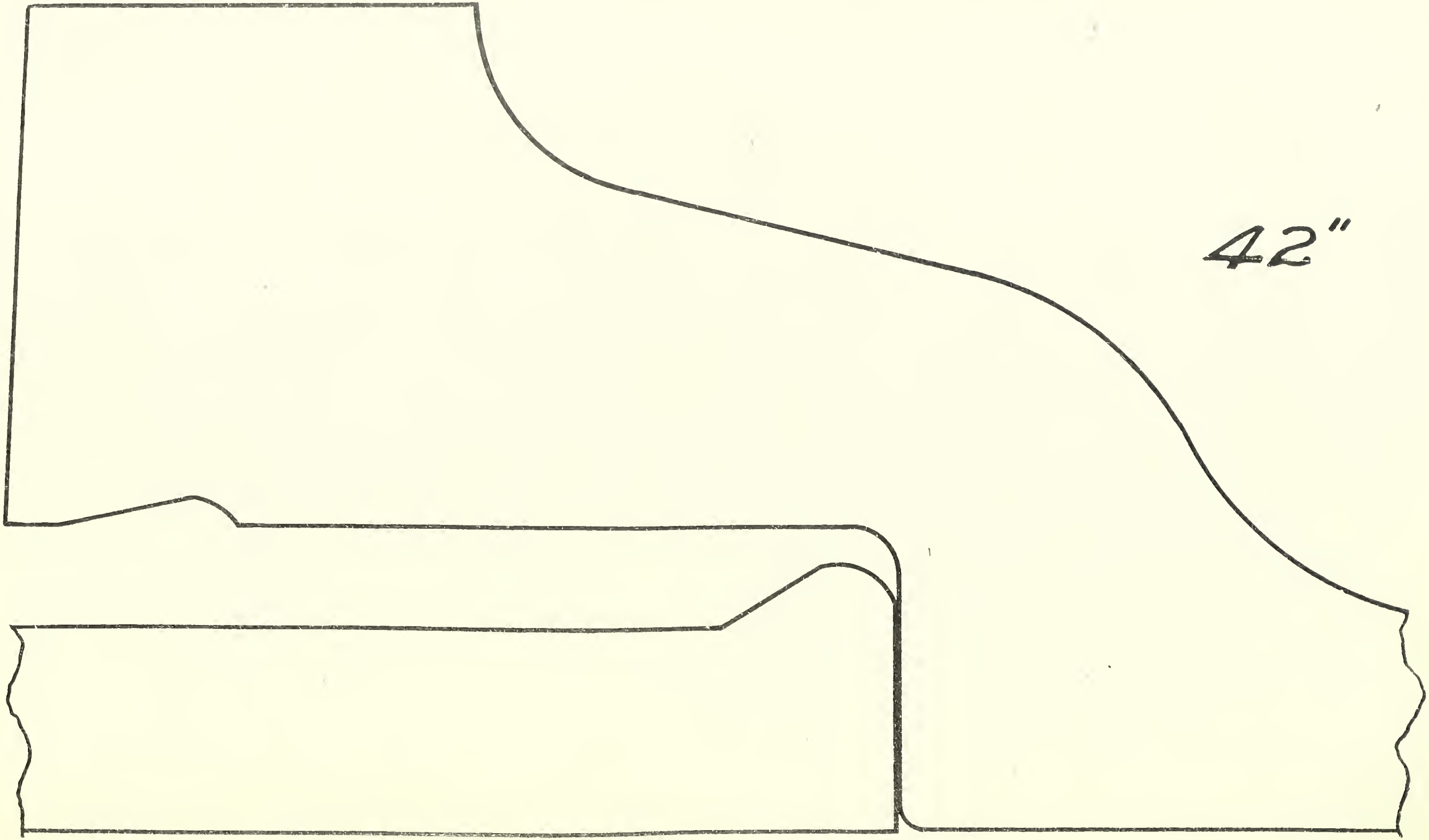

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For the sizes above 8″, the two sections more nearly approach each other in shape, the "A" ones being actually larger than the "B" in width of bell at face, but still lacking in thickness at the bottom of the bell, though the difference in the case of the 30″ is negligible.

The depth of the bell is the same for both systems, except for 12″ and 16″, where the "B" bells are 4½″ in depth, as against 4″ for the "A." Here again, the argument is that the ½″ is warranted by the greater security it affords of tightness of joint, it being always remembered that more and more under city conditions, it is impossible to lay pipe just as one would like to, and that therefore there are many cases where joints must be broken a good deal, making the deep bell of value.

The great length of bead given to the "A" pipe is, supposedly, designed to care for the impurities which sometimes collect in the spigot end, the idea being that with the "A" bead, the lower portion of it at least will be solid. The advantages of a solid bead, as far as the chances of gas leaking through it are concerned, do not especially appeal to the writer, because it seems to make little difference how the gas gets behind the lead in a joint, whether between the spigot and the bell through the yarn, or through the spigot and the yarn, for in any case it is the lead which is to be the final stop. Therefore, if the writer is correct and the "A" form of bead is to counteract the effect of impurities, it would seem to be a remedy for something which is not bad enough to warrant such a cure. It ought to be understood that in case of large pipe there is always enough metal in the pouring gate above the end of the pipe to care for the greater amount of impurity that will be found in a large mass of iron, and that therefore the beads of large pipe, are no more honey-combed than those of small ones. The disadvantages of the "A" bead would seem to be the deep annular ring between the bead and the inside of the bell, forming a space which probably never gets properly filled with yarn, and the poor opportunity afforded to drive the yarn home because of the blunt surface offered by the concave face of the bead. The "B" bead on the other hand, has a comparatively long bevel towards the face of the bell and the yarn is more easily wedged tight between the bead and the bell.

The consideration of the differences between the lead rings of the two systems is left to a later portion of the paper.

Three-way Branches.—The "A" system of three-way branches (which we shall hereafter denote by tees for the saving of breath) provides for three bell fittings only, both eccentric and center outlets being shown. The writer is very much in favor of using three bell fittings wherever possible, as the result is to diminish the number of spigot pieces left over from any job, but as far as his experience goes, it has never been possible, except at the cost of extra joints, to always use three bell fittings, and therefore, the "A" system should provide for two bell tees with a choice of two lengths at the spigot end, as is done by the "B" system. The use of centre outlets, or, in other words, the cases where centre outlets are preferable to eccentric ones, have been so rare in the writer's experience that it was not thought necessary to include them in the "B" system and so far there has been no reason to think their omission a mistake.

A comparison of the small details of design between the tees of both systems does not disclose any important differences, but the "B" design seems to offer a little less opposition to the flow of gas, and this remark applies to crosses as well.

Four-way Branches.—In the "A" system for four-way branches, or crosses, only all bell fittings are arranged for, centre and eccentric outlets both being provided. The remarks as to the necessity for one spigot end on the run of the fitting made in respect to tees applies to crosses also and the "A" system is incomplete as it now stands.

In both crosses and tees, the use by the "A" system of 5/16″ metal for 3″, and ⅜″ for 6″, is not to be recommended; ⅜″ and 7/16″ respectively being preferred.

Reducers.—The "A" standards show concentric reducers only, making it impossible to drain a larger into a smaller main without a certain amount of condensation being trapped.

The "B" standards on the contrary provide for eccentric reducers and allow for bells on either the large or small end, or for spigots on both ends or bells on both ends. While it may be urged that in most cases the last two classes of all spigot or all bell reducers savor of an unnecessary refinement, there is no question that the eccentric reducer is much preferable to the concentric, and that in practice there is need for two classes, those with bell on small end and those with bell on large end. Both systems allow for about as many reductions in one piece, and in designing a system to suit every one it will of course be well to provide for every pattern that could be asked for, although not often required for ordinary use. For instance, in practice, it seems that the reduction of two sizes as from 12″ to 6″ in one reducer is all that is necessary, and a change from 20″ to 6″ could be made by using 20″ to 12″ and 12″ to 6″, but there might be occasions when it would be extremely inconvenient to have two joints in a change from 20″ to 6″, and the system should provide a pattern from which a 20″ to 6″ reducer could be ordered.

PLUGS.—The form of plug shown in the "A" standards appears to be the same for all sizes. In designing the "B" system, it was thought advisable to provide lugs for convenience in handling heavy plugs on all sizes 12″ and larger. This, of course, is a detail upon which no two people might agree.

DRIP POTS.—Again the charge of incompleteness seems just in regard to the "A" standards. Under city conditions there are so many cases where drips are necessarily close together that it is not reasonable to use as large a size pot in those cases, as it would be in draining long lines, as would be the case in country places or in the suburbs of a large city. Therefore at least two sizes of pot for every size bell should be provided. The design of the top of the "A" drip-pot appears weak and there is no apparent reason why the opening should be made as large as it is.

BENDS.—The "A" standards provide for bell and spigot bends in the three classes shown, to the naming of which serious exception should be taken, the (ordinarily named) 90° bends, being called "full bends," the 45°, "half bends" and the 22½°, "quarter bends." There is no inherent advantage in such a system of naming worth the confusion that would result until most of us had managed to remember that a "quarter bend" was no longer ¼ of a circle, or 90°, but was a 22½° bend, being a quarter of what was arbitrarily called a "full bend." In discussing these bends the usual names will be used.

The "B" system provides for bell and spigot bends in all three classes, with a choice of two different lengths of spigot, and in addition in sizes 4″ to 12″ inclusive, for double bell or double spigot bends. Much practice under city conditions has proven to the writer that there is a wide field of usefulness for these double bell and double spigot bends, especially in the 4″ and 6″ sizes of the 45° bends, and many neat pieces of work under trying conditions could never have been made if the "A" standards had alone been available.

The radii of curvature of the "A" bends are longer than those of the "B," and this may be an advantage from the standpoint of gas flow. Where long and gradual curves are required, the "B" system makes use of a circle bend with a five ft. radius forming the arc of a circle with a deviation of 60°.

SLEEVES.—The "A" standards provide for but two lengths of sleeve, 9″ and 12″. To show the necessity in the larger sizes for a longer sleeve than here provided, let us consider the case of a sleeve joint to be made on a 30″ main, the depth of bell in which according to these standards is 4¾″. The piece to fit the gap must be cut, say ¼″ shorter in order to allow for play so that when it has gone home on the bell or the spigot as the case may be, there is a gap of 4¾″ plus ¼″, or 5″. Therefore the 12″ sleeve will cover a space of 3½″ of iron at one end, 5″ of air at the middle, and 3½″ of iron at the other end. Of course, the air space can be wrapped with sheet iron, but at the same time, with the short amount of projection at each end of the pipe into the sleeve, and with the perfectly straight sleeve shown by the "A" standards, there being no key-ring, it is reasonably sure that the sleeve joint will be the worst in the line. Besides this, our supposition infers that both ends of the gap are exactly square with each other, something which seldom obtains in large pipe. In many cases when we join 30″ pipe with a sleeve of the "A" system there would be at certain points in the circumference, not more than 2″ of iron projecting into the sleeve. Therefore the lengths of the sleeves should vary according to the size of main, and the writer's idea of correct dimensions is shown by the "B" system, where a 36″ sleeve is 18″ long and a 2″ sleeve 8″ long. You will note that the "A" system does not provide for 2″ sleeves. Unfortunately all companies still have 2″ mains in existence and while they are being replaced as fast as possible, it is often necessary to use in repair work, 2″ sleeves both solid and split.

The remarks as to length of sleeves applies to split as well as solid, the extra length of the split sleeves being often very valuable in covering a long break.

There seems no reason why a key-ring should not be provided for in sleeves, as well as for ordinary bells, and in the "B" system besides doing this, slight projections have been designed for sleeves 16″ and over in size, to act as some kind of a stop to the yarn.

These remarks not being designed to tell in detail how specials should be constructed, the question of the number of bolts or other details of split sleeves will not be considered.

Flanged Pieces.—The writer does not intend to discuss flanged specials, as they are practically never used in street main work, and if the "A" standards are supposed to cover flanged pipe, there are a number of specials which go with such work that ought to be included.

Various Omissions.—The "A" standards do not provide for the following specials: bushings, which have already been described in a former paper of the writer's; hub sleeves, which are split sleeves provided with hubs of various sizes, and are designed for connecting large to small mains; service sleeves, which are split sleeves strengthened by a boss through which are tapped holes of various sizes, and designed for the connection of large services to small mains; hat flanges, which are designed for the connection of small mains to very large ones; and curtain drips.

The foregoing criticisms of the "A" standards are the writer's reasons for not using them, and his suggestions above for their improvement could be embodied in the one statement to substitute the "B" standards. At the same time, the latter system, while meeting the requirements of the company for which it was designed, would have to be broadened before adoption by this Association. The writer believes that the only way to design a set of standards which will be used by the members of the Association, is to put in charge of such work a committee drawn from those interests which require the largest amounts of castings. A set of standards thus prepared which will embody all the patterns thought necessary by such a committee, and which will be so complete that every information that the manufacturer wants as to the construction of his patterns, can be obtained from the specifications and plans, will be very apt to come into universal use because if the manufacturers are told that the large interests want their castings made according to these standards, patterns will be changed accordingly, and because uniformity conduces to economy, the smaller buyers who take what is sent them, will also be supplied from the standard patterns. A common standard in another branch of gas material was reached in just this way, viz., of the smaller buyers being given what the larger ones insisted on.

The President :—Although the hour for adjournment has arrived, unless there is objection, we will continue the session for twenty minutes longer. This is a very important topic ; and I think there are several gentlemen here who are desirous of discussing it, and the opportunity is now given them. Shall we hear from Mr. Miller ?

Mr. A. S. Miller (New York City) :—I think the principal question ought not to be whether some other standard is as good as that of the American Gas Light Association, but whether some other standard is better. If some other standard is only as good, then, of course, there is no occasion to make any change ; but if some other standard is better the Association wants it.

One of the main things bearing on the question of leakage and of making a change, is this very lead crease which Mr. Forstall is apparently not prepared to discuss at this time. I would like to say in this connection that the principal idea in designing that crease was to so form it that it would hold the lead in the joint. It was intended to allow the lead to go in easily, and at the same time keep it in. The ordinary method of stopping motion is to place the resistance at right angles to that motion. According to that this " B " standard is so designed as to keep the lead from going into the joint, and make it easy to come out ; while the "A " standard was designed so as to let the lead go in, and keep it there when it gets there.

The question as to the form of the bead, I am sorry to say I cannot answer. It was taken from an old design, and for various reasons a change was not considered. But that is a minor detail, and as far as I know nobody is following it exactly

Coming to the general proposition : On getting up the details of drawings for this Association, hoping that the matter would be brought out in full at this time, I found that there were a large number of minor points that could not be followed ; but I did find that the outside dimensions, that is, the dimension from bottom to bottom of the bells, or from face to face of the flange, could be adhered to. These are things in which Gas Companies will be very much interested. Whether there is a difference of one-sixteenth or one-thirty-second of an inch here or there in some parts of the pipe—so long as it is strong enough will not make much difference. But it will make a difference whether it is twenty-four inches from face to face of the flange, or from bottom to bottom of the hubs, or twenty-five, twenty-six or twenty-seven inches. And I see no reason why the gentlemen in getting up their standards could not, if they did not, follow the standards of this Association; in which case, with a proper lead crease, we would about as willingly have theirs as any other.

Those are the principal points. It is hardly fair to even suggest that in getting at the right standard we intended them to be limited to the number of specials shown. As a member of the Association I would not be willing to adopt any standard, in any connection whatever, and say that I would never use anything else where the standard would not fill the bill. Of course, I would use the standard where it is possible to do so. As matter of fact I am using these standards; and consider it quite proper to add to them as occasion demands. But those who have had the work in hand have never felt encouraged to extend the standards, knowing that members of the Association do not use those which they now have.

As to the number of hubs and spigots on specials, there should be standard bodies to hold the standard hub, or flange or spigot. You might ask for as many hubs or spigots as the occasion might require, and all that the foundry would have to do would be to fit the pieces together. If the standard is too light, as suggested, then we should strengthen it. The minor dimensions we could change without seriously interfering with the pattern; but as to the general scheme, if it is not right, we had better change it.

The President:—If no one cares to discuss the subject any further, I would ask Mr. Forstall to close the discussion.

Mr. Walton Forstall (Philadelphia):—I take it that the whole idea of this is simply to give our reasons for not using the Association's standard. I am perfectly willing to admit that in minor details, where we have differed from the Association, they are probably as right as we are. The reason why we did not adopt their minor details I am not prepared to talk about now, but I am willing to repeat what I said before, that in the light of my present knowledge I would advocate the lead crease of the

Association rather than the one we have in our own book. I believe the easiest way to get the standards adopted is to make them perfect and complete. We can have a standard body and use that, and put on a spigot piece of any length we want, or a bell or a flange. At the same time the more completely every little detail which can be thought of is gone into by the committee preparing the standards, the more useful the standards will be I think it will never be gotten into satisfactory shape until a committee is appointed by this Association on the lines I have submitted. Just as in uniform accounts there is a committee preparing accounts who represent the people who keep the most books. so, I think, that the committee appointed by the Association should represent the people who use the most pipes. I believe if such a committee was appointed, they could take the Association standards and use them to a very large extent, and that the result would be a nearer approach to a complete standard than we have ever had before. I do not believe anything that the committee brought out would entirely fill the bill, for the chances would be that after a while some one would realize that they wanted something that was not in the book. We have already had to paste in several pages since we got our book out. There is always new experience to reckon with, and we want to make our book complete in the light of the latest experience.

Mr. A. E. Forstall (New York City):— \s to the committee representing the largest users of specials. I might say that the Committee which now has the matter of standards in charge has on it two members who probably represent two of the largest users of specials in the country; so the Committee as now constituted would seem to fill that requirement.

The President:—What disposition do you wish to make of this subject?

Mr. W. C. Morris:—I move a vote of thanks to Mr. Forstall for his paper.

Carried.

The President:—We have still some questions in our Question Box, which we would like to have answered, if possible.

Is the method of supporting mantles in the centre superior to the old side-rod support?

The Secretary:—I presume that means incandescent mantles, but it does not say so.

The President:—Does any gentleman desire to answer that question?

Mr. R. M. Searle (Mount Vernon, N. Y.):—I do not think the centre support has had quite as much success in this country as it has had abroad. In companies which make relatively high candle-power gas, the centre support cools the Bunsen flame, causing a deposition of carbon, which in time builds up and seriously interferes with the proper combustion of the Bunsen flame.

To what temperature is it economical to heat oils before they are sprayed on the checkerbrick? What are the most economical means of obtaining this temperature?

The Secretary:—I suppose that means the checkerbrick in carburetted water-gas apparatus.

The President:—Who will answer this question? Will Mr. Donahue?

Mr. E. J. Donahue (Philadelphia):—There is a great difference of opinion in regard to heating oils. I do not believe in heating all oils used in a water-gas apparatus. It is easier to maintain heats in a carburetter if the heaviest grade of oils are heated to about 300 degrees.

What is to be done with the small consumer—or rather the would-be small consumer, who wants to use one light or one 1-burner hot plate?

Mr. R. M. Searle:—I do not think we have such consumers. Unless it is for purposes of accommodation, I think I would say that it would not pay to serve him. I do not think we have a class of consumers in this country who require only a one-hole hot plate. No one can get any sort of a meal in this country with only a one-hole hot plate.

Mr. A. E. Forstall:—I think the man who asked that question has had some such consumers in mind, or he would not have asked it. I would say, Take him, if you can make him pay a meter rent that will cover the cost of keeping his account, besides paying for the gas that he uses; and then trust to getting him to use enough gas to do away with the meter rent. I know that Mr. Searle thinks I am utopian and ideal in that, but I think it is better to take a small customer in this way and make him profitable to the company, which he will not be if you take him on, and charge merely the same price per thousand that you do the large consumer.

Mr. R. M. Searle :—If that class of consumer exists in the territory covered by the man who asked the question, it would appear to me to be a colored population, and in that case it would require a prepayment meter and add so much money to the cost of installation that the gross income would not cover the expense.

Have any gas companies sent out their bills in postal card form, printed on the back thereof, and if so, does the plan work satisfactorily? Does the cheapening of distributing the bills and facilitating the office work off-set the objection of undue publicity of a consumer's account that such form of bill involves?

The President :—Has Mr. Morton ever done this?

Mr. F. N. Morton (Hoboken, N. J.) :—As I understand it, it is against the law in this country to dun by postal card.

Mr. J. D. McIlhenny (Philadelphia) :—I know of one company which a few years ago sent out its bills in this way. Having many thousand customers it may be a great convenience for a company to adopt this plan. While I cannot answer the question asked, I can say that I have sent bills out in that way and continue to do so.

Mr. G. W. Clabaugh (Omaha, Neb.) :—It is not a dun; it is simply a notice. You cannot dun a man through the mail. The Water Company in our town sends out its bills on postal cards. I asked that question of the Postmaster at one time, and he took it to Washington, and was able to speak advisedly on the subject.

The President :—You will have noticed that the second paper on the list, and the only one on the list not yet read. is "The Analysis of Gas Accounts," by Mr. Paul Doty. I have a telegram from Mr. Doty expressing his regrets at being absent, and his inability to read the paper, and asking on that account that his paper be withdrawn. He evidently desires to be present at the discussion of the paper.

Is the Committee on Final Resolutions ready to report?

Mr. Jas. Ferrier (Columbus, Ga.) :—Your Committee on Final Resolutions begs to present the following: That the hearty thanks of the Association are due to the Committee of

Arrangements for the thorough and successful manner in which they have striven to promote the comfort, the instruction and the entertainment of the members of the Association in their meeting in this historic city of Boston. Their labors have resulted in benefit both in and out of our sessions.

That the thanks of the Association should be tendered to the President and his co-adjutor, the Secretary, for their able, impartial and businesslike conduct of the meetings.

That the thanks of the Association are owing to those members who have so successfully endeavored to demonstrate the advantages of membership in this Association, and have thus secured the gratifying increase recorded at this meeting.

That the Association owes its sincere thanks to those members who have prepared and presented the valuable papers read at this meeting, every one of which bears the stamp of hard work, and all of which are calculated to lighten the labors of gas managers.

JAMES FERRIER,
I. C. BAXTER,
J. P. HARBISON,
Committee.

On motion of Mr. Walton Forstall, the report was adopted.

MR. WALTON FORSTALL:—I move that the Association now take a recess until the return from the excursion on Friday afternoon, October 18th, and that the final adjournment be had at that time.

Carried.

THE PROCEEDINGS

OF THE

American Gas Light Association.

TWENTY-NINTH ANNUAL MEETING.

1901.

APPENDIX.

PAPERS READ AT THE MEETING.

PAGE.

Further Notes on Retort House Practice, E. H. Earnshaw.......... i
Tar and Water from Water-Gas, Wm. E. McKay xxi
Retort Ovens as Producers of Illuminating Gas, T. Littlehales...... xlvii
What is the Business of a Gas Company? Frank D. Moses........... lxx
Fuel Value of Residuals, Charles F. Prichard...................... lxxvii
In Memoriam xciii
  " William G. Abel.............................. xcvii
  " Alfred C. Gandey xcviii
  " Harold Humphreys............................. xcix
  " David W. Crafts c
  " Charles C. Fry ci
  " William Stacey cii
  " James Slade...... ciii
  " George B. Neal..... civ
  " Wm. E. Barrows cv
  " Wm. Wallace Goodwin............................ cvii
United States Patents Relating to Gas:
  Issued October 1st, 1900, to October 1st, 1901.................. cxi
  Expired October 1st, 1900, to October 1st, 1901................ cxlvi
Current Gas Literature:
  Publications Referred to clviii
  Organization. clviii
  Finance.. clxi
  Process clxii
  Plant clxiv
  Material clxvii

PAGE.
Current Gas Literature (*continued*):
  Manufacture ... clxvii
  Storage ... clxix
  Distribution ... clxix
  Lighting ... clxxii
  Heating ... clxxv
  Power ... clxxv
  Residuals ... clxxvi
  Chemical ... clxxvii
  Physical ... clxxviii
  Photometry ... clxxviii
  Management ... clxxix
  Electrical ... clxxxi
  Acetylene ... clxxxii
  Miscellaneous ... clxxxii
New Publications ... clxxxv
List of Officers for 1901-1902 ... clxxxvii
" Members, Alphabetical, Honorary ... clxxxix
" " " Active ... cxc
" " " Associate ... ccxxx
" " Geographical ... ccxxxviii
" " Deceased ... cclvii

ILLUSTRATIONS.

PAGE.
Standpipe Cleaning Tools ... xiii
Sections of Retort Oven ... xlix
Sections of Boiler Furnace for Burning Coke ... lxxxi
Section of Underfeed Stoker used in Burning Coal and Coke Breeze ... lxxxvi
Tar Burner and Position Occupied in Boiler Furnace ... lxxxviii

FURTHER NOTES ON RETORT HOUSE PRACTICE.

Written for the Twenty-ninth Annual Meeting of the American Gas Light Association by E. H. Earnshaw, Philadelphia.

The last quarter of the nineteenth century has been a period of rapid development in all branches of industry, but perhaps in no case has time wrought more significant changes than in the art of producing illuminating gas. The commanding importance assumed by the rapid development of water gas methods and apparatus, for a long time diverted attention from coal gas affairs, but of late years there has been an awakened interest in improved methods of coal gas manufacture. The effect has been that in many instances the coal gas manufacturer of to-day finds that instead of plain settings he has now to do with regenerative benches and labor saving machinery. The change frequently means the re-education in the art, of the Superintendent himself as well as the foreman and employees under him. His workmen must now be selected with a view to their intelligence as well as their ability to do manual labor.

The Company with which I am connected has in the last three years installed two retort houses, containing 540 retorts in full depth regenerative settings of 9's, and it was found necessary in changing from the older methods to the new to make many changes in our force of employees, training new foremen and workmen, and dropping others who were too old or otherwise unable to accommodate themselves to the new conditions.

Our experience in developing a new force to handle regenerative benches intelligently has brought the thought to me that while several excellent papers have been read before this and other Associations, there might yet be something said that would assist the younger members who may be called upon for the first time to operate benches of this description. The paper read before this Association, by its present Secretary, Mr. A. E. Forstall, in 1895, entitled "Retort House Design and Practice" is a standard article to-day, and covers the subject most admirably; but I hope in this paper to enlarge upon and emphasize some points which it has seemed to me would be of more value when presented in greater detail.

The first thing to be done in starting a new setting is to thoroughly dry the brickwork. A fire should be started in the grate, keeping the clinkering door open and all other openings tightly closed, excepting the main stack damper, which should be opened sufficiently to provide a gentle draught through the stack. The fire is stoked through the charging door, and the coke kept pushed away from the front of the grate, so as to leave a free space at the front to admit enough air over the top of the fire to completely burn all carbonic oxide. This is most important, as any accumulation of unburnt gases in the setting will form an explosive mixture, liable to become accidentally ignited and cause serious damage to the setting.

This slow fire should be kept up until the brickwork is thoroughly dry, which will take from one to three weeks, depending upon whether the setting is entirely new or whether the arch has simply been refilled. At the end of this time the stack damper should be opened wider, and the fire forced to a white heat, still carefully regarding the precaution that enough air must be admitted above the fire to burn all carbonic oxide completely below the furnace arch.

A small stream of water is supplied to the ash pan from the very start in order to prevent the pan from getting hot, and cracking when water is finally put in it.

As soon as the brickwork in the combustion chamber shows a bright red heat, all danger of an explosion has passed.

The primary and secondary air slides are now opened, the clinker door closed, and the furnace filled with coke. If hot coke is available the furnace may be entirely filled at once, but with cold coke, put in a little at a time to avoid cooling the fire too much. Blue flame will now be observed issuing from the nostrils, or openings in the arch between the generator and the combustion chamber, and the setting is ready to receive the adjustment of dampers and slides, necessary to bring the heats up slowly and uniformly.

If we now pause to consider the theoretical conditions existing in a regenerative setting, we will find it easier to formulate the proper method of making this adjustment. In a regenerative setting the furnace or generator is simply a gas producer, usually located under the setting for convenience, and also, in order to enable the heat of primary combustion to be fully utilized. The air entering through the primary air openings is heated by contact with the walls of the waste gas flues, and enters the generator through the primary air ports under the grate, and, together with steam, passes up through the hot body of coke. The resulting producer gas passes through the openings in the furnace arch into the combustion chamber, and is there met by the secondary air, which, entering at the secondary air openings, has travelled through the recuperative flues in close contact with the waste gas flues carrying highly heated products of combustion to the chimney stack. The secondary air thus absorbs heat from the waste gases, which would otherwise be carried away and lost, and returns it to the setting.

The highly heated secondary air provides the oxygen necessary to burn the producer gas, and the flame thus produced in the combustion chamber is very intense. Just enough secondary air is admitted to completely consume the quantity of producer gas formed in the generator, as any excess of air will lower the temperature of the flame and also carry away from the setting to the stack the heat necessary to raise the excessive amount of air to the temperature of the waste gases.

The greater the pull exerted by the chimney, the greater will be the tendency to draw the products of combustion directly from the combustion chamber over the lower side retort and into the waste gas flues. The smaller the pull on the setting, the greater will be the opportunity for the heated gases to reach all parts of the setting and give a regular and uniform distribution of the heat. Moreover, an excessive pull from the stack has a tendency to cause a blow pipe effect in the combustion chamber, concentrating heat at that point and resulting in destruction of the brickwork.

It will be readily seen, therefore, that the bench should be run with the stack damper opened only wide enough to permit the products of combustion to escape without causing an actual back pressure on the setting. With dampers and slides adjusted in any position, the amount of secondary air drawn in is practically a constant quantity, but for a given opening of the primary slides, the amount of carbonic oxide produced will vary with the condition of the fire; consequently the most important point in maintaining regular and uniform heats is the care of the fire, and every effort should be made to keep the body of coke of uniform depth, and the clinkering and shaking up of the fire should be so regulated that the resistance to the free passage of air through the fire should be as nearly as possible the same at all times.

Returning now to the adjusting of dampers and slides to raise the heats, it is evident that as but little producer gas will be required at first, the primary slides should only be opened a little. The secondary air slides are adjusted so as to provide only just sufficient air to consume the producer gas, and the stack damper set so that there is no decided pull on the setting. The chief precaution to be observed at this time is to bring the heats up slowly and evenly. The subsequent life of the setting will, in a great measure, depend upon careful handling at this time. The brickwork necessarily expands with the increasing heat, and time is required to allow this expansion to take place without cracking or otherwise injuring the setting. The proper adjustment of the secondary air is obtained by noting in the waste gas flues above the stack damper the disappearance of the blue flame indicating the presence of carbonic oxide. Assuming that the air slides are 7 inches high, which is a common size, the primary slides are set at a ¼ inch opening. The secondary air slides are closed until blue flame can be seen in the waste gas flues, and are then gradually opened again until the flame just disappears, waiting a few minutes after each change before noting the effect. The stack damper adjustment is not of great importance at this period, but the pull on the setting should not be too great.

As the heats come up the primary air slides should be opened gradually, ⅛ inch at a time, and the secondary slides adjusted to correspond. The stack damper will probably have to be opened wider from time to time to permit the escape of the increased amount of combustion products.

As soon as the retorts are hot enough to burn off a light charge, the regular charging of the coal should be begun, and the raising of the heats continued, so that at least a week will elapse from the time that the retorts are first charged until the full working heat of the bench is obtained.

When the bench has reached a good working heat, the stack damper should be adjusted so that there is no decided pull or pressure on the combustion chamber. The method of obtaining this condition is well described by Mr. Forstall: "The chimney dampers are pushed in until, on opening the charging door of the furnace and throwing in a handful of coal dust, the resulting flame plays lazily back and forth out of the door, neither being drawn steadily in by the draft, nor burning up too vigorously from excess of pressure."

As long as the benches are run at a moderate temperature the waste gas flues should not show anything above a dull red at the point of entrance of the secondary air, and under these conditions it is easy to notice the presence or absence of unconsumed carbonic oxide.

If the benches are pushed to such a temperature that the make per mouth piece reaches 11,000 cubic feet per day or over, the temperature of the waste gas flues will considerably increase, and it then becomes a matter of great difficulty to distinguish whether any flame is present.

In regulating the secondary air to these conditions, the temperature of the waste gas flues and the general condition of the setting must be taken into consideration. A smoky appearance in the flues indicates too little secondary air, and a very clear heat indicates too much. The waste gas flues should show the same heat on each side, and this heat should not be higher than a dark red in the bottom flue nearest the stack.

It will frequently be observed that one side of the bench heats better than the other side, and on observing the waste gas flues, it will be seen that one side is also hotter than the other. To overcome this condition it will be necessary to push in the stack damper and increase the secondary opening on the hot side, and correspondingly increase the damper opening and decrease the secondary opening on the cold side. This will cause the hot gases to travel to the cold side and the flues will gradually heat up. As they become hotter the damper and slides should be gradually restored to their former condition. The principle of this adjustment is that the stack has become more highly heated on the hot side than on the cold side with a consequently stronger draught; and it is necessary therefore, at first to produce abnormal conditions to force the gases to travel through the stack having the lesser amount of draught. As the cold chimney stack becomes hotter, the draft increases, and therefore, the dampers should be gradually changed until they are equally opened again.

The final adjustment of the dampers and slides to secure the most economical operation of the bench is a matter for careful experiment, bearing in mind that the primary air slides must be opened sufficiently to secure the production of the necessary carbonic oxide and the stack damper must be adjusted to the smallest opening consistent with maintaining the required heat in the setting.

The sensitiveness of a full depth, regenerative setting is very great. The balance of the bench is easily disturbed, and changes in regulating dampers and slides should be made with great caution, and only after full consideration. In this connection it is of great assistance to keep a full record of all the changes made on the bench, giving the reasons for making the change and the apparent effect: It should also be remembered that the full effect of any change will scarcely be obtained in less than 24 hours.

If a bench is not heating properly, a diagnosis of the trouble should be made somewhat in the following manner:

The first thing to be determined is whether the furnace is consuming the normal amount of coke. This is most important and is the key-note to the whole situation, but is often disregarded.

An accurate record should be kept at all times of the amount of coke charged into the furnace, so that a deficiency or an excess of coke will be promptly noticed. If the furnace is found not to be burning the normal amount of coke, the condition of the fire should be examined at once and, if necessary, clinker the fire, whether it is schedule time for such a thing or not. The nostrils, or openings in the furnace arch, should also be carefully examined to make sure that they have not become partly obstructed. If this does not remove the trouble, increase the primary openings until the consumption of coke becomes normal, at the same time regulating the secondary air to correspond to the increased amount of the producer gas. Examine the waste gas flues and see that they are normally heated and free from dirt. The waste gas flues should be regularly cleaned, about once in six weeks or two months, as an accumulation of dirt in them prevents the heat from being properly communicated to the secondary air. On the other hand, if the amount of coke consumed is found to be excessive, one of several conditions may be responsible for the poor results. There may be too much draft on the setting, which would be indicated by overheated waste flues, a sharp heat in the combustion chamber, but upper retorts poorly heated. A marked excess or deficiency of secondary air would each result in poor heating of the bench, but the presence or absence of flame or a smoky appearance in the waste gas flues would quickly indicate in which direction the trouble lay.

When the dampers and slides have once been satisfactorily adjusted, it will very seldom become necessary to make any alterations in them except to control the distribution of heat in the bench as already described.

It sometimes happens, especially as the bench gets old, that pieces of tile will fall into the nostrils and obstruct them to such an extent that the normal operation of the bench is interfered with. It is frequently very difficult to entirely remove these obstructions without shutting down, and in some cases the efficiency of the bench will be seriously affected.

An instance of clogged nostrils occurred in one of our benches, and the resulting condition of the setting was interesting and instructive. The bench was not heating well, and the consumption of the coke was low. Opening the primary slides to their fullest extent did not materially increase the production of producer gas and it was nccessary to increase the stack damper opening. This had the effect of increasing the coke consumption, but the flues became overheated and the bench still did not heat properly. The choked nostrils offered a resistance to the free passage of the producer gas from the generator to the combustion chamber, and diminished the effective draft through the fire to such an extent that the formation of the necessary amount of producer gas was prevented. Increasing the damper opening caused such a pull in the combustion chamber that the effect of the choked nostrils was overcome, but the products of combustion were drawn too quickly to the stack, resulting in overheated waste gas flues and irregular heats in the retorts. Evidently some means must be devised to get sufficient producer gas into the combustion chamber without disturbing the normal condition of affairs above the furnace arch.

It was decided then to put a small steam jet blower in the primary flue in order to produce a forced draft under the grate, and enable us to reduce the stack damper opening and restore normal conditions above the furnace arch. As soon as this was done conditions improved, and we were able to get a satisfactory heat in the setting with a normal consumption of coke.

As a practical instance of the proper adjustment, benches are run with the stack damper open from 5 inches to 5½ inches, the damper being 15 inches wide. The primary air slides, which are 7 inches high, are opened 2 inches and the secondary air slides, also 7 inches high, opened 2½ inches. With this adjustment there is attained a high and uniform heat with an average make per mouthpiece of about 11,500 cubic feet per day, and an economical consumption of coke in the furnace. The actual consumption of coke is a difficult matter to determine with accuracy.

When the fuel used in the generators is coke from the West Virginia coal, it has been found necessary to clinker the fires as often as once in 24 hours. To trace the effect of the deterioration of the fire on the production of producer gas, and also to see how nearly uniform conditions were maintained in the setting, arrangements were made to analyze samples of producer gas and waste gas at regular intervals throughout the 24 hours. A number of analyses were made, of which three series, taken on different days from the same bench, are shown in table No. 1 In this particular instance it will be noted that the supply of secondary air was slightly deficient at the end of the first six hours after clinkering, but was considerably in excess at the end of the 24 hours. The reduction in quantity of producer gas is very marked during the last six hours, and it is quite clear that the cleaning of the fire could not be postponed.

To investigate still further the conditions existing in the setting, pressures were taken at different points with a King's Arch Gauge, reading to 1-100 inch. The pressure conditions were found to be quite uniform on the benches. and the results tabulated in table No. 2 are representative of all.

TABLE No. 1.—ANALYSES OF PRODUCER GAS AND WASTE GASES FROM REGENERATIVE SETTING.

	Series No. 1.					Series No. 2.					Series No. 3.				
	CO	CO_2	O_2	H_2	N_2	CO	CO_2	O_2	H_2	N_2	CO	CO_2	O_2	H_2	N_2
Samples taken 6 hours after clinkering fire.															
Producer gas...	26.4	7.0	0.2	12.2	54.2	27.9	5.8	0.2	14.9	51.4	25.8	7.3	0.4	12.1	54.6
Waste " ...	2.1	18.4	0.6		79.9	1.3	18.9	0.4		78.4	1.8	17.9	0.5		79.8
Samples taken 12 hours after clinkering fire.															
Producer gas...	21.8	7.1	0.3	11.7	59.1	22.2	7.3	0.3	3.7	66.5	29.4	3.6	0.3	6.6	60.1
Waste " ...		19.7	0.5		78.8		18.7	1.7		79.6		18.9	1.2		79.9
Samples taken 18 hours after clinkering fire.															
Producer gas...	24.6	8.0	0.3	14.4	52.7	22.8	9.1	0.3	17.4	50.4	26.9	8.0	0.3	17.3	47.5
Waste " ...		19.7	0.5		78.8		19.5	0.6		79.9		18.9	0.5		80.6
Samples taken 24 hours after clinkering fire.															
Producer gas...	29.9	5.9	0.2	14.3	49.7	26.8	7.9	0.3	14.1	51.1	28.7	5.5	0.3	15.0	50.7
Waste " ...		16.0	4.0		80.0		14.0	6.3		79.7		14.2	5.9		80.1

NOTES TO TABLE NO. 1.

Producer gas samples taken under furnace arch.

Waste gas samples taken in waste gas flues, above stack damper.

All samples were taken two (2) hours after charging furnace with coke and one (1) hour after shaking up fire.

ADJUSTMENT OF DAMPERS.

Stack damper opening....................	5¼	inches	x	15 inches
Primary air opening......................	2¼	"	x	7 "
Secondary air opening....................	2¾	"	x	7 "

TABLE NO. 2.—PRESSURES AT DIFFERENT POINTS IN FULL DEPTH REGENERATIVE SETTING

	Bench No. 15.	Bench No. 17.	Bench No. 18.
Chimney flue, below stack damper	–0.19	–0.18″	–0 22
Waste gas flue, above " "	–0.10	–0.10	–0.10
Entrance to recuperative flues....	0.00	0.00	0.00
Combustion chamber...........	0.00	0.00	0.00
Below furnace arch..............	0.00	0.00	0 00
Under grate..................	–0.01	–0.02	–0 01
Entrance to primary air flue.....	–0.03	–0.03	–0.03
" " secondary "	–0.06	–0.07	–0.05
Adjustment for slides, etc.:			
Stack damper opening......	5½″ × 15″	5½″ × 15″	5¼″ × 15″
Primary air "	2″ × 7″	2″ × 7″	2¼″ × 7″
Secondary air "	2¼″ × 7″	2¼″ × 7″	2¾″ × 7″
Maximum vacuums:			
Chimney flue, damper closed.	–0 26	–0 25	–0 27
Primary flue, prim. slide closed	–0.07	–0.09	–0.06
Secondary " sec. "	–0.09	–0.09	–0.08

As has been said, the care of the fire is most important. The fires should be clinkered often enough to keep them in good condition, but no definite rule can be given for this, as the character of the fuel, amount of ash it contains, hardness of clinker formed, etc., will be found to be the controlling factors. With the coke from Pennsylvania coal, we have found it best to clinker every 48 hours. About once in four hours the fire is shaken up thoroughly with a slicing bar, running it up along the side walls to cut off any loose clinker, which, if allowed to remain, is likely to harden and become difficult to remove. With coke from West Virginia coal, the character of the ash makes it necessary to clinker the fires every 24 hours, and the fires are also shaken up every two hours instead of every four. Every effort should be made to keep the fires in uniform condition and to prevent the coke from getting low in the furnace. About 15 minutes before feeding the fire with coke, the charging door should be opened and the coke pushed well to the back of the furnace. This is of material assistance in maintaining a uniform bed of coke. The door covering the charging hole should be carefully watched to see that it fits tightly, and that no air is drawn in at that point, to cause secondary combustion under the furnace arch. Whenever this door gets red hot it is an indication that the coke is too low in the furnace, or that secondary combustion is taking place below the furnace arch.

It is difficult to explain how to clinker a fire, as it is an art that must be learned in actual practice, but it should be done thoroughly and quickly. The general method is to drive secondary bars through the fire above the clinker line, in order to support the coke while the clinker and ashes are being removed. Enough of the regular grate bars are taken out to allow the clinker and ash to fall into the ash pit, the hard clinker is cut away with chisel bars, and as soon as the fire is cleaned the regular grate bars are put back in place, the temporary bars withdrawn and the coke allowed to fall upon the grate. Care should be taken that there is a sufficient body of coke in the fire to prevent cold air from being drawn into the setting. It is the usual custom to use flat bars 3 x ¾ inch for the temporary bars, but where the fire is difficult to clinker, we have found that these bars become hot and will not hold the fire up long enough. We, therefore, use square bars of 1¼ inch iron and have found them much more satisfactory.

We have not found it good practice to admit steam under the grate for the reason that the quantity of steam admitted cannot be controlled with sufficient accuracy, and the result is likely to be an irregular production of producer gas, and, of course, irregular heating of the bench. Steam necessary to keep the grate bars cool and to soften the clinker is provided in a regular amount by the evaporation of the water in the ash pan.

Coming now to the work on the charging floor, the one thing which makes most for smooth running is the proper care of the stand pipes. No matter how well everything else may be run, stopped stand pipes mean poor results and worn-out, discouraged men. We have found that the only way to avoid stopped stand pipes is to keep them perfectly clean. In other words, if the pipes are thoroughly cleaned every time that a charge is put into the retorts, they will not stop up before that charge is burnt off. This is not a hard thing to accomplish if every man does his duty and the work is not neglected. When once the pipes begin to stop up badly, it usually happens that special attention is given to the worst pipes, and those which are apparently clean are neglected, with the inevitable result that all the pipes are more or less stopped up and the work of the house thoroughly demoralized. When a condition of this kind arises, the only remedy is to attack the situation vigorously, burn out the pipes to the iron, and when once clean see that they are kept so.

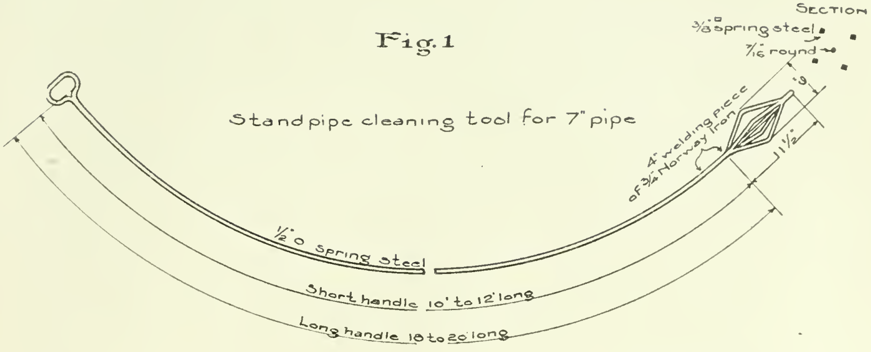
The design and character of tools used for the cleaning of stand pipes vary considerably in different works, and seem to be controlled by local practice. The main point is that the pipes must always be kept clean; the tools used are of secondary importance. The augur described by Mr. Forstall has been and is used with marked success, but has not been adopted in Philadelphia.

In Philadelphia the simple tools shown in Figures 1, 2 and 3 are used and are found very effective.

Fig. 1 shows the principal cleaning tool, known locally as a "basket bull." It is made with two lengths of handle. The tool with the short handle is used at every draw, while the tool with the long handle is only forced up the pipe once in 24 hours.

Fig. 2 shows a basket bull with a straight, jointed handle used for cleaning the stand pipes from the top. It is difficult to force the long bull up the stand pipes belonging to the lower row of retorts, so that when these pipes are cleaned thoroughly once in 24 hours, the jointed bull is used from the top. The jointing of the handle is simply for convenience in using the tool.

Fig. 1



Standpipe cleaning tool for 7" pipe

SECTION
3/8" □ spring steel
7/16" round
9"
11 1/2"
4" welding piece of 3/4" Norway iron
1/2" ○ spring steel
Short handle 10' to 12' long
Long handle 18 to 20' long

Fig. 2

Jointed tool for cleaning stand pipe from top

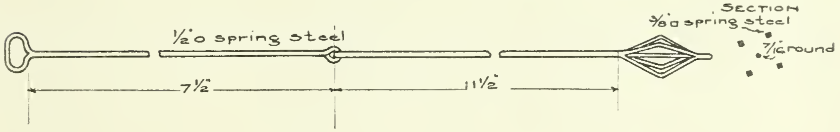
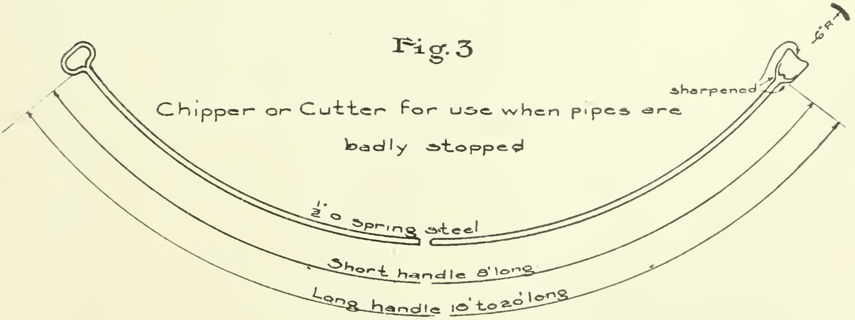


Fig. 3



Chipper or Cutter for use when pipes are badly stopped

Fig. 3 shows the "chipper" or "cutter," which is also made with two lengths of handle, and is used to cut a way through any obstruction too large to permit the basket bull to pass.

There is seldom any necessity for using the long cutter, but the short one is constantly used to cut away slight obstructions near the bend in the stand pipes.

It is the foreman's first duty at the beginning of each shift to measure the cleaning tools and see that they are full size. If they are found to be less than 6 inches in diameter they are sent to the shop.

The $\frac{7}{16}$ inch round tension piece in the centre of the basket bull is very important, as it prevents the ribs from squeezing together.

In ordinary use these tools last a long time and the repairs on them are slight.

Spring steel is used for the handle, because it is stiffer and lighter than iron.

Arranging the work so as to enable the foreman to fix reponsibility for neglected pipes, is a matter of the first importance. The work is sure to be neglected unless this is done, and the method we have adopted is as follows :—

With machine charging and discharging, our working force is reduced to one man to each two benches of 9's. The men work in pairs, giving four benches two men, and each man is responsible for the condition of his particular two benches.

In addition to the care of the stand pipes and bridge pipes, each man sweeps up in front of his two benches after each charge, pushes the coke back in the furnace, cleans the lids and in general sees that everything is kept in good shape.

This plan works well and encourages the men to feel a pride in the condition and appearance of their special charge, and they have all learned by this time that careful attention to the condition of their benches really saves them work.

About 15 minutes before the time for drawing the charge the lids are opened and the stand pipes cleaned. The men are required to force the short bull up the pipe to its full length. If this cannot be done, or if any special difficulty in doing so is apparent, the bridge cap is opened and the pipe burned out then and there. Usually three or four minutes of this burning out is sufficient to enable the bull to be passed up easily. Once in every 24 hours the bridge cap is opened and the bridge pipe thoroughly cleaned. At this time the long bull is forced through the stand pipe from the bottom clear to the top. If this cannot be readily done, the pipe is burned out until the bull will go up easily, which seldom takes more than from five to ten minutes.

Our men work in three shifts of eight hours each, so that the care of the eighteen bridge pipes belonging to two benches is divided among the three men who succeed each other in charge of these two benches during the 24 hours, each man having his particular six bridge pipes to clean. This thorough cleaning of the bridge and stand pipes is done at the beginning of each shift, and is the first and most important duty of each man. This system carefully carried out will certainly result in entire freedom from stopped stand pipes. Even though running with high heats and using a class of coal which makes a very pitchy tar, stopped stand pipes have become, with us, a thing of the past.

While clean stand pipes make smooth running, good carbonization results depend upon the way the coal is put into the retorts, the size of the charge in relation to the size of the retort, and the even distribution of the heat throughout the setting. The charge must be put in as nearly level as possible, neither banked up in front nor in the back, and the heats must be so evenly distributed that this charge will be burnt off in all parts as nearly as possible at the same time.

In coal gas work there is no such thing as averaging results. Having one half a charge too much burnt off and the other half too little will not make an average of one charge well burnt off. In the same way all of the retorts in each bench throughout the house must be evenly heated, as a hot bench will not in any way average up the results with a cold bench. Each retort and every part of each retort must be properly heated and each charge evenly put in to secure the best results. The charge of coal naturally burns off first on the outside, leaving the core not yet thoroughly carbonized. We have found it of material advantage to break the charge with a long slicing bar about an hour before the time for drawing it. We were led to do this because we have often noticed that when a lid is opened a charge may appear to be thoroughly burned off, but as soon as it is stirred up by the drawing rakes a very considerable amount of gas comes off. The gas lost when the retorts are opened for this purpose is much more than compensated for by the better burning off of the charge. As a matter of fact, if this method of breaking up the charge is adopted the time for cleaning the stand pipes can with advantage be moved back an hour, so that the stand pipes can be cleaned and the charge broken up with the one opening of the lid. In this case the pipes are first cleaned and then the slicing bar is used to loosen up the charge and the lid closed. At the time for drawing and charging the retorts an hour later, nothing has to be done to the stand pipes, and the work of charging the retorts proceeds rapidly and without interruption or delay.

Putting in a level charge of coal is easily managed if the work is done with a properly constructed machine, but failing this we have found scoop charging to be much superior to hand charging. Even with scoop charging, however, it is difficult to get the coal placed in sufficient quantity at the back of the retort. The even distribution of heat throughout the setting can, to a certain extent, be controlled by charging the most coal where the retort is hottest, which usually will be in the back of the retort. It is better, however, to put the coal in evenly and obtain even distribution of heat by other means.

The back of the retort being the hottest part of the setting under normal conditions, the heat can be brought forward by reducing the supply of producer gas at that point. To do this the nostrils are partly or wholly covered with tiles, which are pushed over the nostrils a little at a time until the adjustment is found by the results to be about right. It is generally necessary to entirely cover the back row of nostrils, and sometimes an additional row under the middle retort. If the side nostrils are big enough, we believe that overheating of the middle bottom retort can be entirely prevented by sufficiently reducing the size of the nostrils directly under this retort. Unfortunately the side nostrils in our setting are not big enough to permit us to cover the middle nostrils to the extent required, although we have been able to prove to our own satisfaction that in this way the excessive heat of the bottom middle retort can be overcome.

Proper attention to scurfing the retorts is a matter of importance. The carbon should never be allowed to accumulate to an extent that will interfere with the normal operation of the retorts. A good rule is to scurf so many retorts each day that the entire number will be gone over once a month.

In laying out the work of the charging floor we have found it most satisfactory with four hour charges to draw one fourth of the retorts each hour. This arrangement equalizes the work on the men and the make of gas and also divides periods for charging the furnace. An equal number of the furnaces are charged every round instead of charging them all on the same hour, as is sometimes the practice.

The general efficiency of the work in the retort house is promoted by having strict rules in regard to cleanliness. Everything about the house should be kept as clean as possible. The lids, the settings themselves and the floor should be kept clean at all times.

Arrangements should be made to provide suitable places for keeping the necessary tools and they should be kept in their places. The men will do better work, take more pride in their work, and the carbonization results will be better if all work is done in a tidy and neat manner.

The proper relation of the cross section area and the shape of the retort and the size of the charge is too large and important a subject to be properly discussed in a paper of this character, but it may be of interest to give some account of our experience in determining the proper weight of charge for our fixed conditions. Our settings are standard setting of 9's with retorts 16″ x 26″ x 9′ long, designed, we were told, to turn out a make of 10,000 cubic feet per retort per day, with a yield of 5 cubic feet per pound of coal carbonized. Our earlier practice, was, therefore, to charge an average of about 330 pounds per retort, burning off the charge in four hours, so that to obtain the desired 10,000 cubic feet it was necessary to get as large a yield as possible from the coal. With this method of working, things did not go in a satisfactory manner. We had difficulty in keeping the stand pipes clean, and were annoyed by an excessive amount of free carbon in the tar. This was of importance to us, not only on account of the inconvenience and expense caused by thick tar in the mains, but because the contractor for the tar seriously complained of its quality. We were at a loss to explain the exact cause of this condition, and were led to undertake a systematic attempt to study the conditions controlling the formation of free carbon, coming to the conclusion that the carbon was formed in the retort by the contact of the gas with the hot sides of the retort. We concluded that if we could fill the retort as nearly full of coal as possible, that we might be able to overcome the difficulty.

Following this idea, we charged a number of benches by hand, putting 500 lbs. of coal in a retort and burning it off in six hours. We found that under similar conditions, charging the same amount of coal per retort per 24 hours, that the six hour charges gave very much less carbon in the tar than the four hour charges. To test this point thoroughly, we arranged to charge the entire stack with 500 lbs. of coal per retort and six hour charges. We made this change anticipating greatly improved results, but were surprised to find that with the single exception of reducing the amount of carbon in the tar the change was decidedly for the worse. The candle power was lower, and we got less gas per pound of coal. When the retorts were opened the charge appeared well burnt off, but as soon as the drawing rake touched the charge it became evident that the coal in the center was not thoroughly carbonized. It seemed impossible to increase the heat to a point that would thoroughly carbonize this large charge. The retorts being so full of coal, also gave us a great deal of trouble in drawing the coke and our drawing machines were constantly breaking down.

In studying up the results obtained in coke oven practice, it appeared that, in spite of the fact that all of the gas was eventually driven out of the coal, the yields and candle power were low, as compared with retort practice. We then determined to make some laboratory experiments that might throw some light upon the subject. These experiments were designed to show: First, whether the temperature of carbonization had any effect upon the total quantity of volatile matter driven off; and second, how such an effect would be modified by variation in the mass of coal.

A weighed sample of coal was placed in a closed crucible and exposed to a low red heat, until no further gas was given off. The crucible was then heated to the highest temperature to be obtained with a blast lamp, cooled and weighed. The loss in weight represented the volatile matter driven off.

A second sample was carbonized at a bright red heat, driving off the last traces of volatile matter with a blast lamp as before. The experiment was continued by successively carbonizing 1 gram, 3 grams and 6 grams by each of the methods above described. The results obtained are given below. Each experiment was repeated a sufficient number of times to eliminate experimental errors, and the figures tabulated are the average results :—

QUANTITY OF COAL TAKEN.	1 Gram.	3 Grams.	6 Grams
Volatile matter given off, low red heat	36.03%	34.71%	33.77%
Volatile matter given off, bright red heat.........	38.86%	37.22%	36 42%

The conclusions reached were: (1) When gas coal is carbonized in a closed retort, and the carbonization is complete, the proportion between the weight of the coal left in the retort and the weight of the volatile matter driven off is greatly affected by the temperature of the retort and the mass of coal carbonized. (2) The percentage of the volatile matter driven off varies directly as the temperature of the retort and inversely as the mass of coal. The practical application of these conclusions to our work seemed to account, in a measure, for the poor results, and to point to more rapid carbonization and smaller charges. Consequently we determined to make a radical change by adopting three-hour charges.

We began by charging 250 lbs. of coal every three hours, so as to carbonize 2,000 lbs. per retort in 24 hours, as we had been doing. The make of gas and candle power showed an immediate improvement, but in a short time we had blocked the take-off main with lamp black, the stand-pipes stopped faster than we could clean them, and the tar became so thick that it would barely run in a 12-inch pipe. To keep going at all we were obliged to charge the retorts so heavily that the yield fell very low. It was now apparent that we had not appreciated the effect of a small charge in a large retort, and that the large exposed surface of the highly heated retort was the cause of the excessive amount of lamp black. The fact that there is a minimum allowable proportion between the cross-section areas of retort and charge was brought home to us in a vigorous and conclusive manner.

The experience was valuable, and enabled us to understand many things that had hitherto puzzled us. We reasoned thus :

Since high heats and quick carbonization are necessary, we must increase the temperature of the retort; and to avoid excessive free carbon the charge must be as large as possible in proportion to the size of the retort. This brought us directly back to our four-hour charges, but instead of pushing for yield and dropping the heats when the tar became too heavy, we temporarily neglected the question of yield and charged the retorts heavily enough to keep things smooth as the heats of the retorts increased. This plan worked admirably and we have had no trouble since.

For the past year we have been turning out steadily over 11,000 cubic feet per retort per day, corrected to 60° F., sometimes as high as 12,000 cubic feet, and without injury to retorts or settings. We have one stack of 18 benches which has been steadily under fire for more than two years, and it is still in good condition. Only three bottom middle retorts have been blanked, and two of these were lost the first year. We have no trouble with the tar or with stopped stand pipes, and the candle power and yield are satisfactory. The heats necessary to be maintained are so high that we have about reached the limit of the temperature to which we dare subject the brickwork of our settings, but we feel convinced that we could obtain still better results if we could put the weight of the charge still higher. In other words, the results of our experience, while satisfactory in a measure, only show that for our fixed conditions a four-hour charge is better than either a three or five-hour charge, and that 400 lbs. of coal can be carbonized in four hours with reasonable efficiency.

TAR AND WATER FROM WATER-GAS.

WRITTEN FOR THE TWENTY-NINTH ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION, BY WM. E. MCKAY, BOSTON, MASS.

The tar resulting from the use of crude oil, gas oils, or naphtha, in the manufacture of gas, is conveniently called oil-tar; the name suggests a cause and an effect as in the case of coal-tar. Papers on the subject presented before this and kindred associations have dealt with many features of the formation, separation, distillation and use of water-gas tar, oil-gas tar, or preferably, oil-tar. (See Note A, at end of paper.)

The Committee on Research has kept the subject on its permanent list, and this action, with the Secretary's request for additional communications, induces an inquiry as to the reason for the continued attention given to oil-tar. Is there an increasing amount of oil-tar made? Has oil-tar a greater value than formerly? (Note B.) Has the presence of oil-tar become a nuisance that requires abatement? Or, are more companies learning that in the value of this by-product there is a larger percentage of the cost of the raw material than there is in the ammonia from gas coal?

Massachusetts is in the van of industrial development, and for 14 years the reports of the Board of Gas Commissioners have included data that will furnish nearly complete information on some of these points. I have tabulated the data so that an inspection of the tables will show the changes in the manufacture of gas and in the sales of residuals, in Massachusetts, during the past 14 years. In all cases the years end on June 30th. To simplify the figures small fractions have been discarded, and in a few insignificant items an incomplete return to the Board has made necessary an unimportant estimate.

Note C, Table 1. This shows, in cubic feet and in percentages, the coal-gas, the water-gas, and the oil-gas made in the State, also the total gas made. Oil-gas never equaled one-half of one per cent. of the total. In 1887, one per cent. of the total gas made was water-gas; in 1897, 64 per cent. of the total was water-gas.

The water-gas made in 1899 is 115 times the water-gas made in 1887; but in 1899 the coal-gas made is only ⅔ of the coal-gas made in 1887.

The enriching oils used—the sources of oil-tar—are given in Notes D, E and F, Tables II, III and IV, for coal-gas, water-gas and oil-gas, respectively. The oil used per 1,000 cubic feet of gas made is also given. In the case of coal-gas, Note D, Table II, the oil-tar made has mixed with and probably improved the quality of the product sold as coal-tar. It is noticeable that in 1900, the oil used per 1,000 cubic feet of coal-gas is about 3/5 the oil used in 1887, although (see Note G, Table V,) the cannel used in 1887 was 1.9 per cent. of the total coal, while in 1900 the cannel was only one-half of one per cent. of the total coal. This must denote that the higher candle-power is now more generally obtained by mixing with enriched water-gas.

In Note E, Table III, for water-gas, is also given the percentage of each kind of enricher used. In 1900, the enricher per 1,000 cubic feet is only ¾ the amount used in 1887. Naphtha has steadily been the chief enricher, crude oil having considerable use until 1897; after 1897 gas-oil is increasingly used, and in 1900 gas-oil furnishes 55 per cent. of the total oils used, pointing to a larger production of oil-tar.

Note F, Table IV, gives the data for oil-gas, but the tar from this source is evidently a small fraction of the total, though not one to be neglected by makers of oil-gas.

Note G, Table V,—coal carbonized and coal-gas made. The gas per ton of coal has decreased as the enriching oil has decreased. The estimate of 12.5 gallons tar sold per ton of coal is perhaps too high; but even at this figure, 1900 shows nearly 2.3 times as much received per gallon as in 1887. Coal-tar and pitch were put on the free list October, 1890 (corresponding to year 1891 in tables), before that date the duty was ad valorem, 10 per cent on tar, 20 per cent. on pitch.

Note H, Table VI,—total income from sales of residuals, and sales of coke, tar and ammonia; also, the percentages for each residual.

Note J, Table VII,—for coal-gas, income from sale of residuals per ton of total coal used. Here, ammonia is an entirely satisfactory basis for comparison, as this cannot be converted within the works, into fuel, like coke or tar, and the return represents accurately all the value received from this by-product.

Note K, Table VIII, gives returns from sales of residuals for one company, making water-gas only, and shows, the oils used, the tar burned, and the net return from tar sold, per 1,000 cu. ft. of gas made. With a due allowance for value of tar burned, the total value of the oil-tar made per 1,000 for 1900, is higher than the average return (for the State) from ammonia sold per 1,000 cubic feet of coal gas made.

If manufacture in Massachusetts is fairly representative of the whole country, these tables demonstrate that oil-tar is being made in increasing quantities, and that it is a marketable product, inviting the profitable attention of gas makers. (Note L.)

How much oil-tar is made per 1,000 cubic feet of water-gas? Some answers to this question are given in Note M. The fractional distillation of the oil will give some knowledge of the tar that can be expected. In Note N are given typical distillations that were exhibited at the Gas Exposition in Madison Square Garden, New York, 1897. With Lowe double superheater apparatus, I have found the yield of tar for the corresponding oils to be,

With crude oil,	maximum	15.1 %
	minimum	11.8 %
	average	13.5 %
With gas oil,	maximum	18.3 %
	minimum	12.3 %
	average	15 6 %
With Naphtha,	maximum	3.5 %
	minimum	1.7 %
	average	2.6 %

These percentages refer to tar almost entirely free from water, and are determined by the use of large quantities of oils during long periods of time.

The system we have developed for separating the tar from the gas, and the water from the tar, is simple, and has been in part described at several meetings of the New England and other Associations. At the wash-box the seal is carried as light as possible. The water supply for the wash-box is drawn from the tar-well that receives the water and tar flowing from the condensers and scrubbers. The suction of the circulating pump is at a level that returns mostly water to the wash-box, the tar emulsion flowing slowly on into other sections of the tar-wells. The water enters the wash-box at 160° to 170°, and the overflow from the wash-box (returning to the same tar-well from which it was drawn), is 170° to 180°. The gas leaving the wash-box is saturated with aqueous and tarry vapors at 186° to 192°. The gas is cooled by water in tubular condensers, and by air outside the dry scrubbers; it meets no fresh supply of water until it enters the station meter. The gas is cooled to between 50° and 70° as it enters the purifiers; the tar and water that are then mechanically carried by the gas are absorbed by layers of shavings in the usual way.*

No auxiliary heat is furnished in the tar-wells, where the onward flow is only equal to the tar made plus the excess of steam used in the Lowe apparatus; and so the total flow is 1.5 to 3 gallons per 1,000 cubic feet of gas. All of this surplus water and the tar are pumped once each day into a tank, where separation is effected by heat from a steam-coil near (but not on) the bottom of the tank. The usual amount of steam heat necessary for this work is represented by a fuel charge of ¼ lb. coal per 1,000 cubic feet of gas made, but frequently twice this amount is used. We have several times handled the oil-tar from the Wilkinson apparatus, and this we have separated from an emulsion of 66 per cent. water, at a cost of ⅔ of a cent. per gallon of tar recovered.

The tank contents are heated to 212°, and after the necessary interval the steam heat is shut off, and the tank contents cooled to 150°. The tar is then run out and pumped to storage; the water is run out into a filter box, where small, screened generator cleanings remove the traces of tar that are yet held in the water. The tar-wells and the filter-box were designed by Captain Walter R. Addicks, and give excellent service. In the filter-box one ton of screened generator cleanings will clear the overflow from 10 million cubic feet of gas, and will then be good boiler fuel. The water leaving the filter-box is colored with ash (from the generator fuel) holding a little lampblack. This ash and lampblack are very light, and are the troublesome components of the residuals. The ash is of great volume for small weight, and both ash and lampblack are nuclei for naphthalene deposits as they travel with the gas through the apparatus. (Note O.)

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* (See "Berlin normals, Pre-purifiers." American Gas Light Journal, March 4, 1895; Vol. 62, page 300. Also same journal, November 12, 1900; Vol. 73, page 765,—W. C. Morris, on "Removal of Tar from Water-Gas," 28th meeting American Gas Light Association.)

The lampblack, especially, is the general cause of any occasional retardation in the separation of the tar emulsion. In fact, I think that this small amount of free carbon should receive the blame indiscriminately laid upon oil-tar emulsion. In coal-gas manufacture, with zero seal in the hydraulic main, the gas temperature is relatively low, much of the carbon remains in the retorts or standpipes, and the tar absorbs the flocculent lampblack before the scrubbers are reached, incorporating it into the general mass. In water-gas making, the gas, while very highly heated, is forced against a comparatively heavy pressure through a quantity of cool water; after this bath, there is some free carbon that can never be intimately blended with the tar. (Note P.)

In some of the fractions of oil-tar I have found 12 to 15 per cent. of pure benzol, some toluol and allied compounds; some succeeding fractions are nearly all naphthalene. Some of the tar-oils are almost entirely a solution of benzol and naphthalene. But I find that, even with low heats, the use of benzol or naphthalene solutions in the Lowe apparatus, for enriching the water-gas, will break down these fine oils, so that a large volume of lampblack will be found in the tar drains, and the water-gas will receive little light-giving gas. The emulsion of water and oil-tar separates easily under moderate heating, but a considerable quantity of black and water pumped in with the emulsion will either delay the separation, or (occasionally) completely prevent it. An analytical examination of the tar emulsion and of the tar is given in Note Q. The maximum observed efficiency of this system was the separation, from its emulsion, of 3,500 gallons of clear tar per day, using a tank with a capacity of 27,000 gallons, and fitted with a steam coil of 380 feet of one inch pipe, having a heating surface of 128 square feet, and using steam at 110 lbs. pressure.

The Committee on Research suggested that the effect of tar vapors on candle power be determined. The composition of the gas, and the amount of hydrocarbons (tar vapors) removed by condensing and scrubbing have been carefully examined by J. E. Blomen (See "Light, Heat and Power," June 15, 1888.) An abstract of his work is given in Note R. At the Bay State Works, in 1901, a series of observations was made on the candle power of the gas as follows:

LOWE DOUBLE SUPERHEATER APPARATUS.

Month.	Gas Temperature. A	B	Duration of Test.	Candle Power. A	B	Loss of Candle Power. Candles. Per Cent.	Enricher Used.
July	82°	73°	16 days	25.84	25.48	.36=1.4%	Naphtha
August	85°	72°	20 days	25.58	25.54	.04=0.16%	Gas Oil

B is at inlet to station meter.

A is a point in the line of flow so that after passing A the gas flows through tubular condensers, dry scrubbers, the layers of filter shavings and then the oxide in the purifiers. Before reaching A the fresh made gas has passed through condensers and dry scrubbers. I do not regard this test as definitive, and I doubt whether a fair average sample of crude gas—drawn from the apparatus in use—can be delivered unchanged at the burner in the photometer.

In 1897, I undertook an investigation of the physical condition of the gas at successive steps between the wash-box and the street main, but the plural vapors in the gas, and the impossibility of testing exactly the same gaseous mixture at different points along the line of flow, led me to compute the elements of a table showing the probable volumetric and gravimetric changes in carburetted water-gas, saturated with aqueous vapor only. (Note S, Table IX.) Since this table was first published (American Gas Light Journal, March 8, 1897; Volume 66, page 362,) I have made many additional tests on the gas to observe the volume of tar and water condensed from the gas by successive reductions in temperature. In a general way, I have found that, above 100°, the agreement is close between the observed deposition of total liquid (tar and water) and the computed deposition of condensed aqueous vapor, as given in Table IX. The higher the temperature the closer the agreement. Thus, at the wash-box, with gas at 192°, saturated with vapor, the table indicates that each 1,000 cubic feet of holder gas will take from the wash-box 91 lbs. (nearly 11 gallons) of water and tar. Then, measuring the water flowing into the wash-box, and observing the rate of make of the gas, I find that if the supply of seal water falls below 11 gallons per 1,000 cubic feet the seal will be lost; *i. e.*,—the wash-box is being supplied with less water than the gas is taking away.

At temperatures below 100°, the agreement in Table IX between theory and practice is close if the rate of flow of the gas is slow, or if the gas encounters sufficient deposition surface. Thus, in a test from 45° to 36° on a large volume (70 million cubic feet) of gas, the collected condensed water and light tar-oil together agreed exactly with the weight for water only, as given in Table IX. But if the flow of gas is fast, and if the tar and water are not then removed by scrubbing or filtering, the temperature of the gas will fall while it still carries along the condensed entrained water and tar. For the purposes of design of apparatus and manufacture of gas, Table IX is sufficiently accurate to be of practical application. For example, from Table IX it can be deduced that, in general, cooling water-gas by air is not economically practicable. In 1900, at the Bay State Works, a test was made on cooling carburetted water-gas from 180° to 172°, using 5,000 cubic feet air per minute. The heat lost by the gas and the heat absorbed by the air were in satisfactory agreement, and both amounts agreed with the heat as calculated prior to the test, from the data in Table IX. It was found that cooling by air gave no promise of economy, under the existing circumstances of manufacture.

Where no provision is made for repeated circulation of the water as supplied to the wash-box, it is evident that there will at once be set up a heavy flow, ranging in amount from 11 to 7 gallons per 1,000 cubic feet of gas made (11 gallons when running high heats and using hot water in the wash-box, 7 gallons when running low heats and using cold water in the wash-box). This must flow through the tar-well, and thence into some convenient sewer, river or bay. I have observed one drop of tar and lamp-black spread evenly and without a break over 100 square feet of water surface. Thus an uninterrupted overflow from the tar-well may carry away to loss valuable tar, and may contribute cause for complaint.

When the tar and water have been separated from the gas, when the water has been separated from the tar, and when the tar has been sold, or profitably used, this residual should figure in the record of enriching effect of the oil used. If 5 gallons of oil per 1,000 give 30 candle power gas, and if there is a residual of one gallon of tar per 1,000, then—

the gross efficiency of the oil is $30 \div 5 = 6$ candles per gallon;
the net efficiency of the oil is $30 \div 4 = 7.5$ candles per gallon.

Four gallons of the original enricher remain in the gas and give the measured illumination. Any complete statement of carburetted water-gas should include not only the candle power of the gas, and the kind and amount of oil used, but also the amount of clear tar recovered. The best net efficiency per gallon of oil, at Bay State Works, has been—

for gas oil, 7.29 candles per gallon.
for naphtha, 6.72 candles per gallon.

It is always to be expected that laboratory facts will not agree exactly with factory facts. President Charles W. Elliot, of Harvard University, in an address at the Brooklyn Institute of Arts, said, "Any one who desires to attain to the capacity for exact observation and exact description, and knows what it is to draw a correct inference from well determined premises....has learned how hard it is to determine a fact, and to state it accurately."

APPENDIX.

NOTE A. PAPERS BEARING UPON OIL-TAR.

ABBREVIATIONS USED.

A. G. L. A.	American Gas Light Association.
N. E. A. G. E.	New England Association of Gas Engineers.
O. G. L. A.	Ohio Gas Light Association.
P. C. G. A.	Pacific Coast Gas Association.
W. G. A.	Western Gas Association.

In this, and in succeeding notes, all references are to the American Gas-Light Journal, by date and by page, unless otherwise stated.

1891, August 3. Vol. 55, p. 155.	Analysis of three samples of crude petroleum.	—DURAND WOODMAN.
1891, Nov. 16. Vol. 55, p. 695.	The manipulation of tar from carburetted water-gas. A. G. L. A.	—DAVID DOUGLAS.
1892, June 6. Vol. 56, p. 810.	Petroleum products,—hydro carbon employed in gas manufacture. W. G. A.	—C. M. HIGGINS.
1892, Aug. 29. Vol. 57, p. 296.	In a paper on "Enriching Coal-Gas," is an analysis of oil-tar.	—J. MACKAY.
1892, Nov. 21. Vol. 57, p. 729.	Water gas condensation. A. G. L. A.	—J. M. RUSBY.
1893, Jan. 23. Vol. 58, p. 114.	In a paper on "Naphthalene," is a sketch of a still now sometimes used on oil-tar.	

1894, Jan. 8. Vol. 60, p. 38.	Oil Gas Tar. —Durand Woodman.
1894, April 9. Vol. 60, p. 517.	In discussion of paper on "Coal tar pitch," is description of separator for water gas tar for works making 160 to 180 million. —A. S. Miller.
1894, May 14. Vol. 60, p. 690.	Oil gas tar. —Durand Woodman.
1894, June 11. Vol. 60, p. 849.	Separation of water from (coal) tar. —Theodore Petersen.
1894, June 18. Vol. 60, p. 881.	Filter for tar-well overflow. W. G. A., Wrinkle 11. —C. M. Keller.
1894, June 18. Vol. 60, p. 883.	Disposal of fresh water from water gas plant. W. G. A., Wrinkle 18. —W. Lee Brown.
1894, Oct. 15. Vol. 61, p. 544.	Oil gas. (see caption "Tar," page 546.) —Noyes, Blinks and Mory.
1894, Nov. 5. Vol. 61, p. 654.	Petroleum, its products and their relation to the gas industry. A. G. L. A. —C. H. Evans.
1894, Dec. 3. Vol. 61, p. 798.	Lowe's gas cleaner. (Patent specification.)
1895, Jan. 28. Vol. 62, p. 119.	The determination of tar in gas. —W. Leybold.
1895, Nov. 11. Vol. 63, p. 779.	Technical analysis of asphalts. —S. P. Sadtler.
1896, Aug. 24. Vol. 65, p. 282.	Oil tar and its uses. P. C. G. A. —J. B. Grimwood.
1896, Sept. 14. Vol. 65, p. 410.	Tar extractor. (Patent specification.) —I. N. Knapp.
1896, Nov. 23. Vol. 65, p. 815.	The Velna process for the manufacture of briquettes from waste coal and mineral tar.
1896, Nov. 30. Vol. 65, p. 846.	Separation of water gas tar. A. G. L. A. —Alten S. Miller.
1897, May 31. Vol. 66, p. 857.	An oil tar separator and its results. W. G. A. —J. R. Lynn.
1899, Mar. 6. Vol. 70, p. 335.	In a paper on "The nuisance question in gas works," is a description of a tar separator. N. E. A. G. E. —F. H. Shelton.
1899, Dec. 25. Vol. 71, p. 1011.	Texas petroleum. (With fractional distillations.) —F. C. Thiele.
1900, Feb. 12. Vol. 72, p. 246.	In paper on Crystal Palace gas-works is description of circulating water for wash-box seal.
1900, Mar. 26. Vol. 72, p. 482.	Some notes on oil and tar burning. (Coal tar and oil tar.) N. E. A. G. E. —B. J. Allen.
1900, Aug. 20. Vol. 73, p. 282.	Some chemical and physical characteristics of California petroleum. —A. S. Cooper.
1900, Aug. 27. Vol. 73, p. 326.	Tar extractor for tubular condenser. P. C. G. A., Wrinkle 4. —R. L. Clarke.
1900, Nov. 12. Vol. 73, p. 765.	Removal of tar from water gas. A. G. L. A. —W. C. Morris.

1901, Sept. 9. Vol. 75, p. 405.	Practical testing of oils for gas and fuel purposes. P. C. G. A. —L. P. Lowe.

In "Proceedings of American Gas Light Association," Vol. XV, pp. 69 and 70, there is description of apparatus for separating water from oil tar.

Note B. Value of Oil–Tar.

References are to the American Gas Light Journal.

1891, Mar. 23. Vol. 54, p. 399.	We are getting some 6 cents per gallon for water-gas tar, where using crude Lima oil. —F. H. Shelton.
1891, April 6. Vol. 54, p. 486.	Some of it was worked up by simple treatment into an excellent varnish for painting and preserving, selling for $10 per barrel. In several places that I know of 6 to 9 cents a gallon is a current price paid for water-gas tar with water eliminated. O. G. L. A. —F. H. Shelton.
1891, June 15. Vol. 54, p. 853.	Oil-tar is now turned over to chemical works and tar distillers at a price invariably in excess of the cost of an equal quantity of the original oil, and in some localities at double this cost. —A. G. Glasgow.
1891, Nov. 16. Vol. 55, p. 702.	Distillers buy tar with 20% water in it, and pay a price almost as great as coal-tar is selling for in the immediate neighborhood. A. G. L. A. —Alten S. Miller.
1892, Mar. 14. Vol. 56, p. 368.	Oil-gas tar or water-gas tar is really more valuable, when once separated, than is coal-gas tar. N. E. A. G. E. —A. C. Humphreys.
1892, Mar. 14. Vol. 56, p. 369.	The tar from water-gas is unquestionably for many purposes of better quality than coal-tar. N. E. A. G. E. —A. C. Humphreys.
1892, June 6. Vol. 56, p. 811.	In Wilmington, Delaware, tar from oil-gas, (free from water,) is sold at as good a price as coal-tar. W. G. A. —F. Egner.
1892, June 6. Vol. 56, p. 812.	Must regard tar made from use of crude oil as a residual worth from 4 to 10 cents per gallon. W. G. A. —A. C. Humphreys.
1892, June 6. Vol. 56, p. 814.	Cannot get 4 cents per gallon for tar from crude-oil. Am offered 2.5 cents per gallon for tar from naphtha. W. G. A. —C. R. Faben.
1892, Nov. 21. Vol. 57, p. 733.	Tar with less than 8% water can sell for about 70 cents per barrel. A. G. L. A., Question 5. —W. R. Addicks.
1893, June 5. Vol. 58, p. 809.	Coal-tar should be worth two or three times more than oil-tar. —Editorial.
1894, Nov. 5. Vol. 61, p. 656.	2.5 barrels tar equal one ton coal, as fuel. A. G. L. A. —W. H. Pearson, Jr.
1896, Nov. 30. Vol. 65, p. 847.	Worth 1.75 cents per gallon in New York City. Worth for fuel, 1.125 cents per gallon in New York City. A. G. L. A. —Alten S. Miller.
1898, Jan. 10. Vol. 68, p. 53.	7 cents per gallon at Key West. —"Traveller."
1900, Mar. 26. Vol. 72, p. 485.	Worth more than 2 cents per gallon as fuel at Bay State Gas Works. N. E. A. G. E. —W. E. McKay.

NOTE C. TABLE I.

GAS MADE IN MASSACHUSETTS (YEARS END JUNE 30).

IN CUBIC FEET.

Year.	Coal Gas.	%	Water Gas.	%	Oil Gas.	Total Gas.
1900	2,001,542,000	41	2,880,360,000	59	9,075,000	4,890,977,000
1899	1,864,437,000	36	3,265,173,000	64	8,372,000	5,137,982,000
1898	1,759,332,000	36	3,166,847,000	64	8,247,000	4,934,426,000
1897	1,654,454,000	35	3,079,843,000	65	10,965,000	4,745,262,000
1896	1,767,591,000	38	2,875,566,000	62	14,519,000	4,657,676,000
1895	1,532,989,000	39	2,413,266,000	61	12,518,000	3,958,773,000
1894	1,544,787,000	43	2,021,897,000	57	13,100,000	3,579,784,000
1893	2,110,538,000	59	1,466,757,000	41	15,589,000	3,592,884,000
1892	2,326,472,000	65	1,230,816,000	35	13,600,000	3,570,888,000
1891	2,645,861,000	77	777,005,000	23	13,053,000	3,435,919,000
1890	3,138,120,000	94	209,819,000	6	12,476,000	3,360,415,000
1889	3,101,200,000	97	75,696,000	3	11,600,000	3,188,496,000
1888	2,976,881,000	98	47,119,000	2	10,402,000	3,034,402,000
1887	2,738,833,000	99	28,404,000	1	10,600,000	2,777,837,000
1886					10,300,000	2,636,300,000

In 1900, the gas of the Massachusets Pipe Line Company has not been included, because the corresponding residuals are not returned in the Report of the Board of Gas Commissioners. Adding the 664,147,000 made (bought) by the Massachusetts Pipe Line Company, figures of the components and total for the year 1900 become—

	Coal Gas.	%	Water Gas.	%	Oil Gas.	Total Gas.
1900	2,665,689,000	48	2,880,360,000	52	9,075,000	5,555,124,000

NOTE D, TABLE II.

ENRICHING OILS USED IN COAL GAS MADE IN MASSACHUSETTS.

IN GALLONS.

Year.	Naphtha.	*Gas Oil.	Crude Oil.	Total Oils.	Oil per ton of Total Coal.	Oil per 1,000 cu. ft. Gas.
1900	69,754	467,171		536,925	2.86	.27
1899	48,368	435,729		484,097	2.84	.26
1898	105,650	438.990		544,640	3.38	.31
1897	127,172	425,823		552,995	3.62	.33
1896	27,754	396,767	23,545	448,066	2.78	.25
1895	38,120	422,474	38,951	499,545	3.79	.33
1894	315,135	385,570	99,808	800.513	5.62	.52
1893	197,429	297.343	73,281	568.053	2.96	.27
1892	292,122	158,943	214,978	666,043	3.32	.29
1891	1,112,196	146,421	310,791	1,569,408	7.08	.59
1890	826,755	239,703	189,052	1,255,510	4.45	.40
1889	1,145,356	235,635	137,614	1,518,605	5.50	.49
1888	1,112,228	141,400	58,771	1,312,399	4.84	.44
1887	1,045,043	87,843	41,906	1,174,792	4.67	.43

1892	7,921
1891	12,450
1890	46,050
1889	56,300
1888	23,200
1887	10,575

*Under the head of gas oil, there is included residuum as above.

NOTE E, TABLE III.

ENRICHING OILS USED IN WATER GAS MADE IN MASSACHUSETTS.

IN GALLONS.

Year.	Naphtha.	%	Gas Oil.	%	Crude Oil.	%	Total Oils.	Per M.
1900	5,895,090	45	7,133,791	55	898		13,029,779	4.52
1899	11,985,690	82	2,566,953	18	350		14,552,993	4.46
1898	13,396,827	94	860,801	6	350		14,257,978	4.50
1897	7,732,688	56	4,989,264	36	1,094,986	8	13,816,938	4.49
1896	7,203,070	52	3,356,419	24	3,244,197	24	13,803,686	4.80
1895	7,770,199	67	3,565,815	31	289,679	2	11,625,693	4.82
1894	8,877,983	96	47,127		408,672	4	9,333,782	4.61
1893	6,943,377	97			246,642	3	7,190,019	4.90
1892	5,141,406	85			919,371	15	6,060,777	4.92
1891	3,146,445	85			537,822	15	3,684,267	4.74
1890	627,690	59			443,430	41	1,071,120	5.10
1889	321,309	77			97,745	23	419,054	5.54
1888	251,554	83			49,960	17	301,514	6.40
1887	170,823	100					170,823	6.01

NOTE F, TABLE IV.

ENRICHING OILS USED IN OIL GAS MADE IN MASSACHUSETTS.

IN GALLONS.

Year.	Naphtha.	Gas Oil.	Crude Oil.	Total Oils.	Total Oil Per M.
1900	96,573	27,203		123,776	13.64
1899	122,163	25,459		147,622	17.63
1898	128,120	25,571		153,691	18.64
1897	67,452	67,727	17,790	152,969	13.95
1896	123,712	39,630	19,900	183,242	12.62
1895	94,901	21,556	36,955	153,412	12.26
1894	36,452		89,910	126,452	9.65
1893	89,604	22,970	77,592	190,166	12.20
1892	25,416	23,450	74,845	123,711	9.10
1891	46,075	18,956	79,833	144,864	11.10
1890	34,861		86,002	120,863	9.69
1889	43,662		78,470	122,132	10.53
1888	20,061	5,376	95,942	121,479	11.68
1887	11,034	89,380		100,414	9.47

NOTE G, TABLE V.

FOR COAL GAS (MASSACHUSETTS).

I. Year.	II. Coal Tons.	III. Cannel Tons.	IV. Total Coal.	V. Gas Per Ton.	VI. Oil Per Ton. Gals.	VII. (See Below for Explanation.)	VIII.
1900	186,832	992	187,824	10,657	2.86	2,347,800	4.66
1899	169,684	856	170,540	10,933	2.84	2,131,750	4.49
1898	159,882	1,204	161,086	10,921	3.38	2,013,575	6.22
1897	149,487	3,068	152,555	10,845	3.62	1,906,933	6.50
1896	159,188	1,950	161,138	10,969	2.78	2,014,225	6.46
1895	129,560	2,128	131,688	11,641	3.79	1,646,100	6.15
1894	141,243	1,070	142,313	10,848	5.62	1,778,913	6.39
1893	190,759	1,115	191,874	11,000	2.96	2,398,425	6.33
1892	199,491	979	200,470	11,605	3.32	2,505,875	6.62
1891	219,690	1,987	221,677	11,936	7.08	2,770,963	5.67
1890	278,991	3,164	282,155	11,122	4.45	3,526,938	3.33
1889	273,268	3,037	276,305	11,224	5.50	3,453,813	2.69
1888	266,850	4,386	271,236	10,975	4.84	3,390,450	2.41
1887	246,657	4,689	251,346	10,897	4.67	3,141,825	2.13
1886	235,742						

Some coal-tar was burned, or disposed of otherwise than by sale.

Some oil-tar was sold, and the income from this is included in the total income from sales of tar, as reported by the Board of Gas Commissioners. (See Note H, Table VI, for income from sales of residuals).

Not all the sales of oil-tar are separately given in the Commissioners' Reports, but from such companies as are so reported it is found that—

In 1900, 72% of water-gas made yielded $13,528 from residuals.
“ 1899, 77% “ “ “ 9,192 “
“ 1898, 79% “ “ “ 4,638 “
“ 1897, 80% “ “ “ 11,825 “
“ 1896, 66% “ “ “ 1,180 “
“ 1895, 62% “ “ “ 4,308 “

From the water-gas yielding the above residuals, there was tar burned, varying from 70,000 to 537,000 gallons per annum.

As nearly as can be determined from the Commissioners' Reports, the total sales of oil-tar did not exceed,—as follows:—

1900	$18,789	1899	$11,938	1898	$5,871
1897	14,780	1896	1,788	1895	6,498

Prior to 1895 the sales of oil-tar cannot be determined.

If the net incomes from sales of coal-tar thus determined are considered, and if 12.5 gallons coal-tar are sold per ton of total coal carbonized, then (and only with such qualifications) Column VII, Table V, gives the total gallons coal-tar sold. Column VIII, Table V, gives average price, in cents, received for the coal-tar sold.

NOTE H, TABLE VI.

INCOME FROM SALES OF RESIDUALS.

INCLUDES ALL COMPANIES IN MASSACHUSETTS REPORTS.

Year.	Coke.	%	Tar.	%	Ammonia.	%	Total.
1900	$242,896	61	$128,259	32	$28,694	7	$399,849
1899	218,186	63	107,718	31	21,413	6	347,317
1898	205,184	57	131,148	37	19,589	6	355,921
1897	183,739	54	138,649	40	21,625	6	344,013
1896	177,245	53	131,925	39	27,133	8	336,303
1895	168,236	56	107,959	36	22,600	8	298,795
1894	191,388	60	113,732	36	14,858	4	319,978
1893	246,726	58	151,735	36	23,702	6	422,163
1892	241,288	56	165,940	39	21,123	5	428,351
1891	266,581	60	157,183	35	22,812	5	446,576
1890	344,897	70	117,604	24	29,637	6	492,138
1889	350,451	74	92,946	20	29,778	6	473,175
1888	360,435	77	81,647	18	24,060	5	466,142
1887	290,692	76	66,881	18	23,371	6	380,944
1886							347,985

NOTE J, TABLE VII.

FOR COAL GAS, INCOME FROM SALES OF RESIDUALS, PER TON OF TOTAL COAL.

Year.	Coke.	Tar.	Ammonia.	Total.
1900	$1.293	$0.583	$0.153	$2.029
1899	1.279	.562	.126	1.967
1898	1.274	.778	.122	2.172
1897	1.204	.812	.142	2.158
1896	1.100	.808	.168	2.076
1895	1.278	.770	.172	2.220
1894	1.345	.799	.104	2.248
1893	1.286	.791	.124	2.200
1892	1.204	.828	.105	2.137
1891	1.203	.709	.103	2.015
1890	1.222	.417	.105	1.744
1889	1.268	.336	.108	1.712
1888	1.329	.301	.089	1.719
1887	1.157	.266	.093	1.516

The net sales of coal-tar are obtained by deducting from the total sales of tar, the amounts named in the foot-note to Table V as the limiting income from sales of oil-tar. Prior to 1895, the figures are not corrected for any sales of oil-tar.

NOTE K, TABLE VIII.

BAY STATE GAS COMPANY, OF MASSACHUSETTS.

ENRICHING OILS USED.

Year.	Naphtha.	Gas Oil.	Crude Oil.	Total Oils.
1900	54,104	4,722,194		4,776,298
1899	2,723,307	2,076,715		4,800,022
1898	4,528,877	433,576		4,962,453
1897		4,027,181	1,094,636	5,121,817
1896	100,095	2,035,853	3,172,180	5,308,128
1895	383,418	3,522,991		3,906,409
1894	3,959,110	47,127	61,226	4,067,463
1893	4,711,241			4,711,241
1892	4,194,707			4,194,707

Year.	Water Gas Made.	Tar Burned Gals.	Income from Residuals. Total	Per M.
1900	1,013,453,000	70,000	$13,284.73	$0.01311
1899	1,050,195,000		8,924.62	.0085
1898	1,061,850,000		4,289.85	.00404
1897	1,077,467,000	138,873	11,070.89	.01027
1896	1,071,236,000	536,331	955.43	.00089
1895	887,878,000	292,688	3,661.35	.00413
1894	857,739,000		2,933.54	.00377
1893	968,157,000		195.45	.0002
1892	885,480,000		469.63	.00053

This Company has used more than a million gallons of oil-tar as fuel, under several forms of boilers, and the use of the tar has been thoroughly satisfactory for making steam and for saving coal. Three-fourths of a gallon of tar burned per 1,000 cubic feet of gas made furnished all the steam (110 lbs. pressure) used in the works.

(American Gas Light Journal, March 26, 1900. Volume 72, pages 484, 485.)

NOTE L. USES OF OIL-TAR.

References are to the American Gas Light Journal.

1891, Nov. 16. Vol. 55, p. 696.	Makes good, cheap asphalt paths; makes bright, glossy varnish. A. G. L. A. —David Douglas.
1892, Feb. 1. Vol. 56, p. 151.	One gallon refuse oil or tar can yield 500 cubic feet hydrogen. —Reprinted from Gas World.
1892, Mar. 14. Vol. 56, p. 369.	Water-gas tar is better than coal-tar for paint making. N. E. A. G. E. —A. C. Humphreys.
1892, Oct. 24. Vol. 57, p. 579.	Oil from oil-gas . . . a most excellent solvent for poor paint, or paint badly put on. —A. W. Wilkinson.
1892, Nov. 21. Vol. 57, p. 733.	Used for painting buildings and ironwork. A. G. L. A. Question 5. —J. P. Harbison.
1894, April 9. Vol. 60, pp. 516 & 517.	Oil-tar pitch has been used for paving and roofing purposes, . . . with good success. It is a very fair substitute. It does fairly well. O. G. L. A. —Watt (Chicago).
1894, April 9. Vol. 60, p. 517.	A manager of a tar-factory told me that he could not get enough water-gas tar; he has found it makes a perfectly pure asphaltum, a valuable product. It makes a deodorized paper. O. G. L. A. —J. H. Somerville.
1896, Aug. 24. Vol. 65, p. 283.	Used for pavements and paint. P. C. G. A. —J. B. Grimwood.
1896, Aug. 24. Vol. 65, p. 284.	Paint for gas-holder roofs. P. C. G. A. —F. H. Eichbaum.
1896, Aug. 24. Vol. 65, p. 284.	Makes a paint, mixed with turpentine. P. C. G. A. —Powers.
1896, Nov. 23. Vol. 65, p. 815.	Used, with waste-coal, for making briquettes. —Reprint from L'Industrie.

1897, Aug. 16. Vol. 67, p. 250.	Use oil-tar for services, it is the best paint to be used around gas-works, for any kind of ironwork. P. C. G. A. —Thomas D. Petch.
1897, Sept. 13. Vol. 67, p. 407.	Use for paint on ironwork. P. C. G. A. —F. H. Eichbaum.
1897, Sept. 27. Vol. 67, p. 489.	Distillate of oil-tar will remove naphthalene. —Young and Glover (England).
1898, Jan. 10. Vol. 68, p. 53.	For the nets and boats of fishermen. —"Traveller" at Key West.
1899, July 17. Vol. 70, p. 87.	Water-gas tar is a very good preservative for wrought iron pipe. O. G. L. A. —J. R. Lynn.
1901, April 8. Vol. 74, p. 525.	Paint for holder tank and holder, and for brick and stone walls. O. G. L. A. —J. P. Harbison.
1901, Sept. 2. Vol. 75, p. 362.	Used for coating timber posts, in the soil. P. C. G. A. —E. C. Jones.

Note M. Percentage of Tar Made.

References are to the American Gas Light Journal.

Note that the apparatus used is not given.

1890, April 28. Vol. 52, p. 590.	There is no necessity of making a particle of waste oil. —A. W. Wilkinson.
1890, Dec. 8. Vol. 53, p. 804.	14.3 per cent. tar, with crude petroleum. —A. G. Glasgow.
1891, June 15. Vol. 54, p. 853.	With Lima Crude Oil, 15% tar, containing 25% water. —A. G. Glasgow. Note,—this equals 11.5 per cent. net.
1891, Nov. 16. Vol. 55, p. 697.	In 1888, yield was 12.6 per cent. tar. In 1891, yield was 5.6 per cent. tar, from Lima Crude Oil. A. G. L. A. —David Douglas.
1892, March 7. Vol. 56, p. 334.	.7 gallon tar is made per 1,000 cubic feet gas. N. E. A. G. E. —G. B. Neal (Charlestown).
1892, Mar. 14. Vol. 56, p. 362.	2.5 per cent. tar from naphtha. N. E. A. G. E. —W. E. McKay.
1892, April 11. Vol. 56, p. 530.	Water-gas from naphtha yields practically no tar. O. G. L. A. —C. H. Welch, in a paper on "The present and future coal-tar market."
1893, April 10. Vol. 58, pp. 520, 521.	With naphtha, .4 of one per cent. of tar. With crude oil, 7 per cent. of tar. O. G. L. A. —Alten S. Miller, in a paper on "Oils for gas enriching."
1894, Nov. 5. Vol. 61, p. 656.	With crude oil, tar made equals 10 per cent. A. G. L. A. —W. H. Pearson, Jr.
1895, Nov. 18. Vol. 63, p. 815.	One-eighth gallon of tar, per gallon of gas-oil used. A. G. L. A. —E. G. Pratt.
1896, Nov. 30. Vol. 65, p. 846.	8 per cent. tar, with gas-oil or heavy residuum. A. G. L. A. —Alten S. Miller.
1896, Nov. 30. Vol. 65, p. 847.	Tar-well has a capacity for 1.25 gallons tar per 1000 cubic feet gas made. A. G. L. A. —J. M. Rusby.
1899, June 26. Vol. 70, p. 968.	With gas-naphtha, tar is a negligible quantity. With gas-oil, tar is 1.54 per cent. W. G. A. —Paul Doty.

NOTE N.

FRACTIONAL DISTILLATIONS,

EXHIBITED AT MADISON SQUARE GARDEN, NEW YORK,

FEBRUARY, 1897.

BY THE UNITED GAS IMPROVEMENT COMPANY.

NAPHTHA.

Specific Gravity = .6930, or 72° Beaumé at 60° F. Color white.

Fraction.	Vol. %.	Wt. %.	Sp. Gr.	Beaumé.	Color.
100°–150°	10.90	10.34	.6579	83°	white
150 –200	54.09	53.69	.6885	73.5	white
200 –250	28.00	29.07	.7196	64.5	white
250 –300	4.20	4.45	.7370	60	white
Above 300	1.75	1.91	.7560	55	clear red-brown
Residue	none appreciable.				
	98.94	99.46			

GAS OIL.

Specific Gravity = .8462, or 35°.3 Beaumé at 60° F. Color dark.

Fraction.	Vol. %.	Wt. %.	Sp. Gr.	Beaumé.	Color.
180°–300°	4.40	3.83	.7369	60°	white
300 –350	4.55	4.10	.7639	53.5	nearly white
350 –400	3.50	3.24	.7823	49	nearly white
400 –450	6.30	5.95	.8001	45	nearly white
450 –500	6.95	6.73	.8108	40.75	slightly yellow
500 –550	10.45	10.27	.8320	38.5	pale yellow
550 –600	16.35	16.46	.8491	35	pale yellow
600 –650	21 95	22.17	.8625	32.25	pale yellow
650 –700	18.35	18.99	.8764	29.75	yellow
Above 700	7.50	7.98	.9009	25.5	dark
Residue		.30	solid		black
	100.30	100.02			

CRUDE OIL.

Specific Gravity = .8335, or 38° Beaumé at 60° F. Color dark.

Fraction.	Vol. %.	Wt. %	Sp. Gr.	Beaumé	Color.
130°–200°	5.00	4.10	.6840	74°.5	clear white
200 –250	5.20	4.49	.7193	64.5	clear white
250 –300	8.00	7.14	.7443	58	clear white
300 –350	6.30	5.77	.7463	53	clear white
350 –400	6.15	5.77	.7827	49	clear white
400 –450	6.40	6.14	.8000	45	clear white
450 –500	7.40	7.23	.8143	42	slightly yellow
500 –550	7.00	6.94	.8265	39.5	slightly yellow
550 –600	7.40	7.44	.8379	37	pale yellow
600 –640	20.85	21.22	.8484	35	brown yellow
640 –650	16.15	16.48	.8505	34.5	blackish
Above 650	2.00	2.24	.9363	19.5	blackish
Residue		2.94			coke-like
	97.85	97.90			

NOTE O.

ASH, LAMPBLACK AND NAPHTHALENE. ANALYSIS BY DR. WING AT BAY STATE GAS WORKS.

The naphthalene deposit, taken from a condenser tube, after drying, separated into:—

95.9% volatile matter, at 217° F., nearly clear naphthalene, colored by a little oil.

3.5% carbon and dense hydrocarbons.

.6% ash, which formed about ¼ the bulk of the substance taken. This ash is silica, colored by iron.

The bulk of the substance left on dissolving the naphthalene is quite voluminous, although very light in weight; this is the lampblack and ash carried by the gas.

A sample of the sediment taken from below the steam coil, near the bottom of the tar-separating tank, when free from liquid tar, shows the pulverulent residue to be almost entirely lampblack, with 4 per cent mineral matter as dust. This mineral matter is identical with the ash referred to in the preceding analysis.

NOTE P.

FREE CARBON IN TAR.

References are to American Gas Light Journal.

1894, Jan. 8. Vol. 60, p. 38.	9 per cent. lampblack in clear oil-tar. 51 per cent. pitch in oil-tar. —DURAND WOODMAN.
1900, July 16. Vol. 73, p. 83.	Coal-tar has 20 to 25 per cent. of flocculent sooty carbon. —WILLIAM YOUNG.
1901, Mar. 25. Vol. 74, p. 446.	25 per cent. free carbon or lampblack in ordinary gas-house tar. 5 to 8 per cent. free carbon or lampblack in Otto-Hoffman Coke Oven tar. —F. SCHNIEWIND.

In experiment at Bay State Works, W. E. McKAY found 12 to 15 per cent. free carbon or lampblack in oil-tar.

NOTE Q.

ANALYSES OF WATER GAS TAR, BAY STATE WORKS, BY DR. JOHN F. WING.

Sample.	A	B.	C.	D.
Sp. Gr. Beaumé	13°.5	13°.5	13°.5	12°.0
–240° water	.25%	.5%	.25%	14.0%
–240° oil	4.25	2.0	1.75	8.0
240–336	.05	1.0	2.0	.5
336–400	3.0	3.5	3.0	.5
400–550	29.0	23.0	28.0	20.0
550–617	5.0	9.5	8.0	7.0
617–690	17.0	14.5	14.0	11.0
Hard Pitch residue	41.0	46.0	42.5	39.0
Benzol	.5	.25	.25	.5
Naphthalene	22.5	17.0	18.5	13.0

Sample A is the separated stored tar.

Sample B is of the tar as pumped into the separating tank, but before heating; this sample is drawn from the tar stratum in the tank.

Sample C is of the tar as pumped from the tar-well receiving the drains from the last condensers and scrubbers; this sample is drawn from the tar stratum in the well.

Sample D is of the tar as pumped from the tar-well receiving the drains from the wash-boxes, first scrubbers and condensers, from which the circulating pump is supplying the wash-boxes; this sample is drawn from the tar stratum.

Specific gravity of all samples was nearly 1.1 that of water. At 400° the distillate becomes heavier than water.

At ordinary temperatures, the residues left at 550° and 617° were soft pitch, but would not flow.

Note R.

Influence of Condensers and Scrubbers on Composition of Water-Gas, by J. E. Blomen (Chicago.)

	A	B	C
Hydrogen	28.83	28.17	28.40
Marsh Gas	20.12	25.73	25.87
Light Hydrocarbons (CnHn+2)	8.12	6.71	6.68
Heavy Hydrocarbons	10.62	4.70	4.10
Carbonic Oxide	24.18	26.03	26.22
Carbonic Acid	2.71	2.98	3.00
Sulphur	2.37	2.51	2.53
Nitrogen	3.05	3.17	3.20

A is of the gas before all condensers.

B is the gas after passing the first condenser.

C is the gas after passing the second condenser.

	E	F
Inlet to first scrubber	140°.8	60°.25
Outlet to first scrubber	76 .3	57 .9
Outlet to second scrubber	73 .0	57 .0
Outlet to drying apparatus	75 .4	55 .5

At the end of test E, there was 4 per cent. of tar in the sawdust in the purifying box. At the end of test F, there was 6/10 of one per cent. of tar in the sawdust in purifying box.

NOTE S. TABLE IX.

TABLE FOR CARBURETTED WATER-GAS SATURATED WITH AQUEOUS VAPOR, NO OTHER VAPORS BEING PRESENT—SHOWING, WITH CHANGE OF TEMPERATURE, THE CHANGE IN VOLUME OF UNIT WEIGHT OF GAS AND THE CHANGE IN WEIGHT OF UNIT VOLUME OF THE MIXTURE OF GAS AND AQUEOUS VAPOR.

Computed by W. E. McKAY. 1897.

Barometric variations of pressure exceed the usual variations of pressure at different points in a gas works, and the mixture of gas and vapor has been considered as under the normal pressure of 30″ mercury.

Column I. gives the temperature in degrees Fahrenheit.

Column II. gives the tension of saturated aqueous vapor in inches of mercury, corresponding to the temperature in I. This vapor tension is from Dixon's tables for latitude 53°.

Column III. gives the pressure under which the gas is contained; this pressure is 30″—the vapor tension in Column II.

Column IV. gives the volume of unit weight of gas, at the temperature and pressure given in Columns I. and III. Unit weight of gas (51 pounds) is the weight of the gas in the mixture of 1,000 cubic feet of gas and vapor at 60° F Unit volume is 1,000 cubic feet.

Column V. gives the weight of aqueous vapor corresponding to the pressure in Column II. and to the volume in Column IV.; this weight is the aqueous vapor carried by unit weight of gas at the temperature given in Column I.

Column VI., the weight of gas and vapor, is 51 lbs. + column V.

Column VII. gives the weight of the mixture of gas and vapor occupying 1,000 cubic feet at the temperature and pressures stated.

I.	II.	III	IV.	V.	VI.	VII.
Temp. F°.	Vapor Tension.	Gas Pressure =30″—II.	Volume of Unit Weight of Gas. (51 pounds.)	Weight of Volume (Col. IV.) of Aqueous Vapor in Lbs.	Weight of Gas and Vapor =V+51.00.	Weight of 1,000 cu. ft. Gas and Vapor at Temp. I. and Pressures II. and III.
200	23.435	6.565	5700	167.24	218.24	38.29
199	22.953	7.047	5302	152.60	203.60	38.41
198	22.480	7.520	4961	140.05	191.05	38.51
197	22.016	7.984	4666	129.19	180.19	38.62
196	21.559	8.441	4406	119.67	170.67	38.73
195	21.110	8.890	4177	111.25	162.25	38.84
194	20.669	9.331	3974	103.75	154.75	38.94
193	20.236	9.764	3792	97.10	148.10	39.06
192	19.810	10.190	3628	91.08	142.08	39.16
191	19.392	10.608	3479	85.64	136.64	39.27
190	18.981	11.019	3344	80.70	131.70	39.38
189	18.577	11.423	3221	76.19	127.19	39.49
188	18.181	11.819	3109	72.07	123.07	39.59
187	17.792	12.208	3005	68.28	119.28	39.70
186	17.410	12.590	2909	64.78	115.78	39.80
185	17.034	12.966	2820	61.55	112.55	39.91
184	16.666	13.334	2737	58.56	109.56	40.01
183	16.304	13.696	2662	55.77	106.77	40.11
182	15.949	14.051	2591	53.18	104.18	40.22
181	15.600	14.400	2524	50.75	101.75	40.32
180	15.258	14.742	2461	48.49	99.49	40.42
179	14.922	15.078	2403	46.37	97.37	40.52
178	14.592	15.408	2348	44.37	95.37	40.62
177	14.268	15.732	2296	42.49	93.49	40.72
176	13.951	16.049	2247	40.72	91.72	40.82
175	13.639	16.361	2201	39.05	90.05	40.92
174	13.333	16.667	2157	37.48	88.48	41.03
173	13.033	16.967	2115	35.99	86.99	41.13
172	12.739	17.261	2076	34.58	85.58	41.23
171	12.450	17.550	2039	33.23	84.23	41.32
170	12.167	17.833	2003	31.96	82.96	41.42
169	11.889	18.111	1969	30.75	81.75	41.52
168	11.617	18.383	1937	29.60	80.60	41.61
167	11.350	18.650	1906	28.51	79.51	41.71
166	11.088	18.912	1877	27.47	78.47	41.81
165	10.831	19.169	1849	26.47	77.47	41.91
164	10.579	19.421	1822	25.52	76.52	42.01
163	10.332	19.668	1796	24.61	75.61	42.10
162	10.090	19.910	1771	23.74	74.74	42.20
161	9.853	20.147	1748	22.91	73.91	42.29
160	9.621	20.379	1725	22.12	73.12	42.39
159	9.393	20.607	1703	21.35	72.35	42.48
158	9.170	20.830	1682	20.62	71.62	42.58
157	8.951	21.049	1662	19.92	70.92	42.67
156	8.737	21.263	1643	19.25	70.25	42.77
155	8.527	21.473	1624	18.60	69.60	42.86
154	8.321	21.679	1606	17.98	68.98	42.96
153	8.120	21.880	1588	17.39	68.39	43.06
152	7.922	22.078	1572	16.81	67.81	43.15
151	7.729	22.271	1556	16.26	67.26	43.24
150	7.540	22.460	1540	15.73	66.73	42.34
149	7.354	22.646	1525	15.21	66.21	43.42
148	7.173	22.827	1510	14.72	65.72	43.52
147	6.996	23.004	1496	14.25	65.25	43.62
146	6.822	23.178	1482	13.79	64.79	43.71
145	6.651	23.349	1469	13.35	64.35	43.80
144	6.485	23.515	1457	12.92	63.92	43.89

I.	II.	III.	IV.	V.	VI.	VII.
Temp. F°.	Vapor Tension.	Gas Pressure =30"—II.	Volume of Unit Weight of Gas (51 pounds.)	Weight of Volume (Col. IV.) of Aqueous Vapor in Lbs.	Weight of Gas and Vapor =V + 51.00.	Weight of 1,000 cu. ft Gas and Vapor at Temp. I. and Pressures II. and III.
143	6.322	23.678	1444	12.51	63.51	43.98
142	6.162	23.838	1432	12.11	63.11	44.08
141	6.006	23.994	1420	11.73	62.73	44.17
140	5.854	24.146	1409	11.36	62.36	44.26
139	5.704	24.296	1398	11.00	62.00	44.35
138	5.558	24.442	1387	10.65	61.65	44.44
137	5.415	24.585	1377	10.32	61.32	44.53
136	5.275	24.725	1367	10.00	61.00	44.63
135	5.139	24.861	1357	9.68	60.68	44.72
134	5.005	24.995	1347	9.38	60.38	44.81
133	4.874	25.126	1338	9.09	60.09	44.91
132	4.747	25.253	1329	8.81	59.81	45.00
131	4.622	25.378	1320	8.53	59.53	45.09
130	4.500	25.500	1312	8.27	59.27	45.18
129	4.381	25.619	1304	8.01	59.01	45.27
128	4.264	25.736	1295	7.76	58.76	45.36
127	4.150	25.850	1287	7.52	58.52	45.45
126	4.039	25.961	1280	7.29	58.29	45.55
125	3.930	26.070	1272	7.06	58.06	45.64
124	3.824	26.176	1265	6.84	57.84	45.73
123	3.720	26.280	1258	6.63	57.63	45.82
122	3.619	26.381	1251	6.43	57.43	45.91
121	3.520	26.480	1244	6.23	57.23	46.00
120	3.423	26.577	1237	6.03	57.03	46.09
119	3.329	26.671	1231	5.85	56.85	46.19
118	3.237	26.763	1224	5.67	56.67	46.28
117	3.147	26.853	1218	5.49	56.49	46.37
116	3.059	26.941	1212	5.32	56.32	46.46
115	2.974	27.026	1206	5.15	56.15	46.55
114	2.890	27.110	1200	4.99	55.99	46.64
113	2.809	27.191	1195	4.84	55.84	46.74
112	2.729	27.271	1189	4.69	55.69	46.83
111	2.652	27.348	1184	4.54	55.54	46.92
110	2.576	27.424	1178	4.40	55.40	47.01
109	2.502	27.498	1173	4.26	55.26	47.10
108	2.430	27.570	1168	4.13	55.13	47.20
107	2.360	27.640	1163	4.00	55.00	47.29
106	2.292	27.708	1158	3.87	54.87	47.38
105	2.225	27.775	1153	3.75	54.75	47.47
104	2.160	27.840	1148	3.63	54.63	47.57
103	2.097	27.903	1144	3.52	54.52	47.66
102	2.035	27.965	1139	3.41	54.41	47.75
101	1.975	28.025	1135	3.30	54.30	47.84
100	1.917	28.083	1130	3.20	54.20	47.94
99	1.860	28.140	1126	3.10	54.10	48.03
98	1.804	28.196	1122	3.00	54.00	48.13
97	1.750	28.250	1118	2.90	53.90	48.22
96	1.697	28.303	1114	2.81	53.81	48.32
95	1.646	28 354	1110	2.72	53.72	48.41
94	1.596	28.404	1106	2.63	53.63	48.51
93	1.547	28.453	1102	2.55	53.55	48.60
92	1.500	28.500	1098	2.47	53.47	48.70
91	1.454	28.546	1094	2.39	53.39	48.79
90	1.409	28.591	1090	2.31	53.31	48.88
89	1.365	28.635	1087	2.23	53.23	48.97
88	1.323	28.677	1083	2.16	53.16	49.07
87	1.282	28.718	1080	2.09	53.09	49.16

I.	II.	III.	IV.	V.	VI.	VII.
Temp. F°	Vapor Tension.	Gas Pressure =30″– II.	Volume of Unit Weight of Gas (51 pounds.)	Weight of Volume (Col. IV.) of Aqueous Vapor in Lbs.	Weight of Gas and Vapor =V + 51.00.	Weight of 1,000 cu. ft. Gas and Vapor at Temp. I. and Pressures II. and III.
86	1.241	28.759	1076	2.02	53.02	49.26
85	1.202	28.798	1073	1.96	52.96	49.36
84	1.164	28.836	1069	1.89	52.89	49.46
83	1.127	28.873	1066	1.83	52.83	49.55
82	1.092	28.908	1063	1.77	52.77	49.65
81	1.057	28.943	1060	1.71	52.71	49.74
80	1.023	28.977	1056	1.65	52.65	49.84
79	.990	29.010	1053	1.60	52.60	49.93
78	.958	29.042	1050	1.54	52.54	50.03
77	.927	29.073	1047	1.49	52.49	50.12
76	.896	29.104	1044	1.44	52.44	50.22
75	.867	29.133	1041	1.39	52.39	50.32
74	.839	29.161	1038	1.34	52.34	50.42
73	.811	29.189	1035	1.30	52.30	50.52
72	.784	29.216	1032	1.25	52.25	50.62
71	.758	29.242	1030	1.21	52.21	50.71
70	.733	29.267	1027	1.17	52.17	50.81
69	.708	29.292	1024	1.13	52.13	50.91
68	.684	29.316	1021	1.09	52.09	51.02
67	.661	29.339	1018	1.06	52.06	51.12
66	.639	29.361	1015	1.02	52.02	51.22
65	.617	29.383	1013	.98	51.98	51.32
64	.596	29.404	1010	.95	51.95	51.42
63	.576	29.424	1008	.92	51.92	51.52
62	.556	29.444	1005	.88	51.88	51.62
61	.536	29.464	1003	.85	51.85	51.72
60	.518	29.482	1000	.82	51.82	51.82
59	.500	29.500	998	.79	51.79	51.92
58	.482	29.518	995	.76	51.76	52.02
57	.465	29.535	992	.74	51.74	52.13
56	.449	29.551	990	.71	51.71	52.23
55	.433	29.567	988	.68	51.68	52.33
54	.418	29.582	985	.66	51.66	52.44
53	.403	29.597	983	.64	51.64	52.55
52	.388	29.612	980	.61	51.61	52.65
51	.374	29.626	978	.59	51.59	52.75
50	.361	29.639	975	.57	51.57	52.86
49	.348	29.652	973	.55	51.55	52.97
48	.335	29.665	971	.53	51.53	53.08
47	.323	29.677	969	.51	51.51	53.18
46	.311	29.689	966	.49	51.49	53.28
45	.299	29.701	964	.47	51.47	53.39
44	.288	29.712	962	.45	51.45	53.50
43	.278	29.722	960	.44	51.44	53.61
42	.267	29.733	958	.42	51.42	53.72
41	.257	29.743	955	.40	51.40	53.82
40	.248	29.752	953	.38	51.38	53.93
39	.238	29.762	951	.37	51.37	54.04
38	.229	29.771	949	.36	51.36	54.16
37	.220	29.780	946	.35	51.35	54.27
36	.212	29.788	944	.34	51.34	54.38
35	.204	29.796	942	.32	51.32	54.49
34	.196	29.804	940	.31	51.31	54.60
33	.188	29.812	938	.30	51.30	54.71
32	.181	29.819	936	.28	51.28	54.82
31	.173	29.827	933	.27	51.27	54.93
30	.166	29.834	931	.26	51.26	55.05

RETORT OVENS AS PRODUCERS OF ILLUMINATING GAS.

Written for the Twenty-ninth Annual Meeting of the American Gas Light Association, by T. Littlehales, Syracuse, N. Y.

The whirligig of time brings about strange changes, and often illustrates the saying that the new is only the old made over again. Discoveries supposed to be new are often found to be only a fresh bringing to light of facts known long ago. Great latent possibilities and powers often exist unobserved in connection with daily operations, until some radical innovator, who, not content to take things for granted, or as he finds them, turns them upside down, looks under, over and through them, turns them end for end, and possibly turns them inside out and shows us unexpected things.

Ovens for gas-making had been used, and had been superseded by the retort long before many of the members of the American Gas Light Association had ever seen the inside of a gas works. They were largely used in Scotland at one time, and I personally can well remember as a youth, in my student days, hearing ovens defended by one who had used them thirty years prior to that time, their chief merit as compared with retorts being their much greater durability, their chief defect, that the fuel account to heat them was very high. And the differences between the ovens of those days and the present are no greater than between the retort systems of the early period of gas-making and those of the present day.

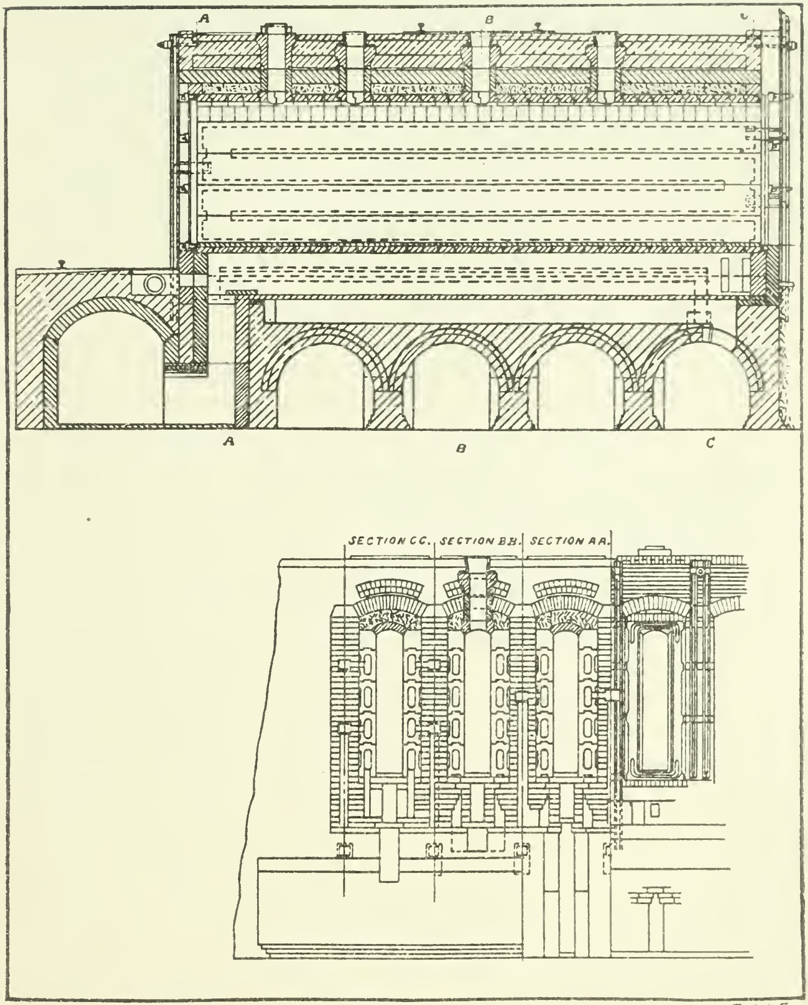
Sometimes things are ahead of their time, or conditions are not favorable to their development. As a notable instance of this latter feature in connection with the gas industry, the following is a striking example:

About fifty years ago two of the eminent London Gas Engineers of that time Messrs. S. and T. N. Kirkham brought forward the idea of making water gas by the decomposition of steam in contact with incandescent carbon, and took out patents for the same, in 1852. But neither London nor Paris could be induced to take it in hand; consequently the idea laid practically dormant for upwards of twenty-five years, when Mr. T. S. C. Lowe, in this country, put the matter on a new basis, and mineral oil having been discovered in the meantime, and Mr. Lowe's efforts being supplemented by the great skill, energy and perseverance of a few others, water gas making became a commercial success. And to-day London, British, and in fact European gas interests generally, have been and are greatly enhanced and benefited by water gas methods, developed, improved and firmly established in the United States and taken back to Britain again a solid success.

I think it justly due to a distinguished member of this Association, and one of its past presidents, to add, in this connection, that probably no one man has done as much to place water gas in the position it occupies to-day in the gas world as our esteemed colleague, Mr. Alexander C. Humphreys.

Then, again, vested interests, with the inevitable conservatism surrounding them, often stand in the way of new methods. But these, however strong, cannot successfully resist the march of progress, and sooner or later they join in the procession and move onward.

From the earliest history of gas manufacture, every progressive gas man has sought to cheapen production by improving the methods, by the introduction of labor-saving contrivances, especially in the handling of coal by machinery, etc., and the gas interests are greatly indebted to those who have been the pioneers in all these efforts for improvements Changes amounting almost to revolutions have taken place in the various phases of the gas industry within the memory of the older members of the American Gas Light Association, and we must not for a moment suppose finality has been reached, but must expect many developments to be revealed by the future, probably to the extent of more revolutions, of which coke ovens, as they have hitherto been called (because the production of coke therein has been the primary consideration) will be one very important and prominent feature; but the time has now arrived when they should no longer be called coke ovens, but gas ovens, or perhaps more correctly retort ovens, because they are, in all essential respects, retorts on a large scale, practically differing only from the ordinary retorts in their greater capacity,



SKETCH #405

SECTIONS OF RETORT OVEN.

and the necessary changes in form of construction to meet the requirements of the larger capacity, and the method of charging and discharging them.

Coke ovens are as old if not older than gas retorts, and upwards of half a century ago the attempt was made to recover the gas and other products therefrom, and in like manner, as I have shown, in reference to water gas development, the by-product recovery has, especially in the United States, laid almost dormant until the last few years, notwithstanding that the increase in coke production has steadily advanced and at enormous bounds.

Mr. John Fulton, member of American Institute of Mining Engineers, in his excellent, able and exhaustive work "On the manufacture of Coke and the Saving of By-Products," says:

"The efforts for supplementing the profits of coke-making by saving the by-products of tar and ammonia from the gases discharged from the coke ovens, occupied the early attention of coke manufacturers. It is recorded that the first coke ovens, producing tar and ammonia as by-products, were constructed at Sulzbach, near Saarbrucken, in 1766."

(Ten years prior to Murdoch's experiments, thirty years before Watt's Soho Foundry was lighted with gas, and fifty years before the first gas company was incorporated in London.)

"Very slow progress was made in the saving of by-products; their practical manufacture and sale in market was not assured until about the year 1883. In 1856, Knab, in France, built a group of coke ovens, in which a double purpose is evident; the saving of the by-products, tar and ammonia. The gases, freed from tar and ammonia, were returned to the ovens and burned in the flues to reinforce the heat for coking. These ovens are described as having narrow vertical chambers, 23 feet long, 6 feet 3 inches high, and 3 feet 3⅓ inches wide (which is clearly the parent of modern by-product or retort ovens). The principal difficulty in extending the use of these ovens, and which has only recently, been corrected, consisted in the neglect of proportioning the several parts of the oven to the requirements of the quality of the coals to be coked. With the advent of correct dimensions in the retort ovens, to meet the wants of the various qualities of coal, their increased use in the manufacture of coke and saving of by-products has been largely extended.

"In 1862 Simon & Carvés, of France, made very valuable improvements in the original plan of the Knab oven.

"The construction of this Knab-Carvés oven with important improvements in 1873, to assure the better distribution of heat, afforded a model for subsequent coke ovens.

"Hüessner built 100 ovens in 1881, establishing the by-product industry on a sound basis in Germany.

"The first ovens on the principle of what is now known as the Semet-Solvay Retort Ovens were constructed by M. Semet at Mons, in Belgium, in 1882, and the system has gradually since that time been growing until at the present time there are many hundreds of ovens in operation."

The capabilities and possibilities of such gas-generating plant as retort ovens are of such character as to make it absolutely certain that they have "come to stay," because they contain features of advantage distinctly in advance of existing methods.

The prediction was made many years ago that the time would come (in consequence of the variety and value of the products obtained from the distillation of coal) that if gas were entirely superseded for lighting, coal would have to be distilled specially for tar and the many things derived therefrom, even if the gas were useless, and comparatively few persons are aware of the large number and great variety and value of products that chemical science has succeeded in producing from tar and liquors from coal gas manufacture. Probably no one thing or substance known of to-day has added so largely to the list of things of value in the arts, in medicine and in the sciences and manufactures generally as coal tar has done. So that far-fetched and extreme as most of the gas men thought that prediction to be, it is to-day an accomplished fact. It is no longer a theory, it is an actual condition, and one to be seriously faced and dealt with. There are places to-day where the gas is being absolutely wasted from these retort ovens, and yet the products coke, tar and ammonia make the business a commercial success, so that when gas can be made for nothing per 1,000 feet, it is quite evident it can be sold from the ovens considerably cheaper than most gas companies can make it.

And as Mr. Shelton has given such an excellent practical demonstration and proof of the fact that ordinary illuminating gas can be economically and satisfactorily carried under high pressures for long distances, these facts, coupled together, will in the future exercise considerable influence on the gas business.

Disturbing as it may be to some, and hurtful as it surely will be to others, it will, like all true progress, eventually redound to the benefit of humanity.

One of the great scientists of the past, Dr. Siemens, predicted that the time would come when in thickly populated localities solid fuel would be a thing of the past, and year by year a little further advance is being made toward that goal of comfort and happiness to mankind, and the by-product or retort ovens will make a bigger stride in that direction than most people are at present aware.

One great advantage of the by-product or retort oven process over the ordinary retort process is in the character of the coke produced.

The whole mass, as it comes from the retort oven, is a first-class furnace coke (provided the coal used is capable of making a first-class furnace coke in a beehive oven). If proper precautions are taken, it can be made equal to the best 72-hour foundry beehive coke, suited to the highest requirements.

So that to-day the factors of the problem of gas manufacture are being slowly, but none the less surely changed, and in certain localities where there is a demand for metallurgical or blast furnace, or foundry coke, instead of the gas being the prime consideration, it is a minor one, and the gas often has to be dealt with, as most of the older gas men have in past times had to do with their tar, burn it. Of course it seems rather strange to a gas man to have to burn millions of cubic feet per day of good gas under steam boilers and other apparatus simply to use it up: *gas that can with very little trouble and expense* (*a few cents per* 1,000 *feet only*) *be made as available and as suitable for public use as that made from retorts and sent out from the gas works*, and it seems hard to make the average gas man realize this. And a market must as naturally be sought for the by-product gas as the gas man does for his by-products, coke, tar and ammonia.

There are very many localities where foundries and other businesses use up a great deal more coke than the gas company of its locality produces, probably ten times as much, even if the gas retort coke were suitable, which it is not, for blast furnace or foundry purposes, being too soft and porous, while the retort oven coke can profitably supply the demand *for every kind of coke required, from the hardest foundry coke to that suitable for domestic purposes.*

The retort oven, if properly constructed and managed, can be and is being profitably operated from the standpoint of coke and by-products alone, even if there were no means of disposal of the gas.

Of the gigantic character and extent of the coke industry few people have any adequate conception.

The following figures will, perhaps, aid in a fuller and clearer understanding of the subject. My calculations are based upon a U. S. Government report for the year ending 31st of December, 1899, by Mr. Edward W. Parker, Statistician U. S. Geological Survey, on "The Manufacture of Coke." This report was issued from the Government Printing Office in Washington, 1901. Mr. Parker's figures are on the following table:

COKE OVENS IN THE UNITED STATES IN 1899:

COAL USED THEREIN AND COKE PRODUCED THEREFROM.

FROM REPORT BY MR. EDWARD W. PARKER, STATISTICIAN, U. S. GEOLOGICAL SURVEY, ON "THE MANUFACTURE OF COKE," WASHINGTON: GOVERNMENT PRINTING OFFICE, 1901.

In 1899. Order of rank in Coke Production.	Coal used. Short tons.	Coke produced. Short tons.	No. of Ovens on Dec. 31, 1899.	No. Building in 1899.
Pennsylvania	19,930,419	13,577,870	27,591	1,666
West Virginia	3,802,825	2,278,577	8,846	619
Alabama..........	3,028,472	1,787,809	5,599	850
Virginia	994,635	618,707	1,588	429
Colorado	898,207	530,424	1,243	50
Tennessee		435,308	2,040	62
Massachusetts	Included with Penna.	......	400	....
Ohio	142,678	83,878	385	....
Kentucky.........	151,503	81,095	300	130
Montana	110,274	56,376	303	....
Georgia	78,098	50,907	350	100
New Mexico......	68,594	44,134	190	....
Wisconsin.........	54,950	33,437	120	....
Washington	50,813	30,372	90	....
New York........	Included with Penna.	......	25	5
Utah.............	Included with Colorado.	......	104	....
Indian Territory...	59,255	24,339	130	100
Wyoming.........	32,100	15,630	74	....
Kansas...........	26,988	14,476	95	....
Missouri..........	5,320	2,860	12	....
Indiana .... }	......	......	52	....
Illinois .... }	4,217	2,370	130	26
	30,219,343	19,668,569	49,667	4,037
			of which 808 are by-product ovens.	

NOTE.—The figures given for Pennsylvania State, include the coke from the by-product ovens in Massachusetts and New York; which, however, is not large enough to materially affect the calculations herein submitted.

The table shows, first, the tonnage (2,000 pounds) of coal used in 1899 in coke-making.

Second—The coke produced therefrom.

Third—The number of ovens in operation December 31st, 1899.

Fourth—The number of ovens building in the same year.

From which it will be seen that in the whole of the United States in 1899 there were upwards of thirty millions tons (30,219,343 tons) of coal converted into coke by coke oven processes, and nearly twenty millions tons (19,668,569 tons) of coke produced therefrom.

The relative consumption of coal and output of coke in each State will be seen by reference to Mr. Parker's table.

Probably about 95 per cent. of this vast quantity of coal is carbonized in ovens from which coke is the only product and consideration, and 5 per cent. only carbonized in by-product ovens. The gas, the tar and the ammonia from the old-style ovens go absolutely to waste.

Let us glance at what this colossal waste amounts to.

Assuming that with by-product or retort ovens, after deducting the necessary gas used to heat the ovens, 4,000 feet per ton of coal can be recovered, *and that this can be done is beyond question; it is being done on a large scale in a number of places day in and day out the year round*, and has been so carried on for a number of years. It means that the gas wasted from the manufacture of coke, as at present generally carried on in the United States is about as follows:

And take first the State of Pennsylvania alone, in which the coke business is about 65 per cent. of that of the entire United States. (But it should here be noted that Mr. Parker's figures for Pennsylvania include Massachusetts and New York State, but inasmuch as the make of coke in these two States is small in comparison, it does not materially affect the calculations).

The coal consumed in coke-making in 1899 in Pennsylvania alone, according to Mr. Parker's figures, was nearly twenty million net tons (19,930,419), and the coke produced therefrom thirteen and a half million tons (13,577,870).

Assuming the recovery of 4,000 feet of gas per net ton (at present wasted from old style ovens) it would equal 79,721,676,000 cubic feet per annum, equal to 12,649 feet per capita of the entire population of Pennsylvania (as given by Rand & McNally at 6,302,155) which is about double the per capita consumption in our largest cities, and four or five times the average per capita consumption in all the cities of the United States, outside the five largest ones.

It is equal to the supply of ten cities the size of Philadelphia, with its population of 1,294,000 and allowing for the consumption of 6,000 feet per capita of its population per annum.

It is equal to the supply of 40 cities of the size of Pittsburg, with its 325,000 population, assuming a consumption of 6,000 feet per capita of population.

It is equal to the supply of nearly 4 (actually 3.8) cities the size of Greater New York, with its 3,437,000 inhabitants, on a basis of 6,000 feet per capita per annum.

It would equal the output, *nearly seventeen times over*, of 25 of the largest gas companies in Massachusetts, as per the following list the figures of which are taken from the valuable Report of the Massachusetts Gas Commission. These twenty-five places average an actual consumption per capita of the populations of the districts supplied, of 2,245 cubic feet per annum.

As proof of this assertion, the figures in the Report of the Massachusetts Gas Commissioners, published in 1901, show that in twenty-five of the largest gas companies in that State, the output (gas sold and used) was equal to 2,245 feet per capita of the population of the districts supplied; and ranged from the Boston Gas Light Company 6,573 cubic feet per capita, down to some of the smaller cities with less than 1,000 cubic feet per capita per annum.

OUTPUT (GAS ACCOUNTED FOR) OF 25 OF THE LARGEST GAS COMPANIES IN MASSACHUSETTS IN 1900.

Order of rank.	Gas sold and used in thousands.	Population of Districts supplied.	Consumption per capita of Population.
1. Boston Gas Light Co.	1,097,648	167,000	6,573
2. Brookline	676,029	438,000	1,543
3. Lowell	347,894	106,000	3,282
4. Cambridge	277,547	92,000	3,017
5. Worcester	264,904	118,400	2,237
6. Roxbury	233,372	105,400	2,214
7. Dorchester	231,180	84,000	2,752
8. Lynn	186,203	78,000	2,387
9. Fall River	169,957	105,000	1,618
10. Springfield	153,126	70,000	2,656
11. Lawrence	140,058	74,000	1,892
12. Charlestown	136,366	67,000	2,305
13. South Boston	119,259	68,000	1,753
14. Newton and Watertown	101,898	50,000	2,038
15. Jamaica Plain	87,839	98,500	892
16. New Bedford	83,409	62,400	1,336
17. Malden and Melrose	82,476	46,000	1,793
18. Salem	57,713	47,000	1,228
19. Taunton	54,600	31,000	1,760
20. East Boston	51,088	46,000	1,110
21. North Adams	43,180	24,200	1,784
22. Brockton	40,411	40,000	1,010
23. Chelsea	33,582	34,000	988
24. Fitchburg	25,045	31,500	795
25. Northampton	24,120	18,600	1,297

4,718,904,000 ÷ 2,102,000 = 2,245

It is equal to more than double the combined output of the three great gas companies of London, England, viz., The Gas Light and Coke Company, The South Metropolitan Gas Company, and the Commercial Gas Company; and this, bear in mind, from the State of Pennsylvania alone.

And a safe estimate of the value of this gas, and other products now being wasted, would be about as follows:

Gas at 10c. per thousand feet only, the value would be	$7,972,167
Tar, say 8 gallons per ton, at 2c. per gallon, “	3,189,867
Ammonia, at 16 pounds per ton only, at 2½c. per pound	7,972,167

Or a total result, in products wasted, of............$19,133,201 per annum, every dollar of which may be saved.

And taking the whole of the coke ovens in the United States, on the same basis of calculation, viz., 4,000 feet only of gas recovered from 2,000 pounds coal; then, with a consumption of coal, as shown by Mr. Parker in the annexed table—of 30,219,343 tons, the gas wasted is 120,877,372,000 feet per annum. Sufficient to supply the whole demand, of the *forty largest cities in the United States*, allowing a consumption, per capita, of 8400 feet per annum, for the combined populations, aggregating upwards of fourteen millions of inhabitants (14,373,828) as per the accompanying list of cities with their populations, as taken from the World Almanac for 1901, and this allowance of 8,400 feet per capita, is certainly more than double the actual average consumption in the whole of the forty cities, so that the gas which might be saved, in the manufacture of coke, in the whole of the United States, by the use of retort ovens, would be more than sufficient to supply such a list of cities as given, *twice over.*

And as the increase in coke making goes on in the United States at the rate of about 1,200 ovens, or about one million tons of coal per annum this represents 4,000 millions cubic feet further waste; nearly equal to the supply of the twenty-five largest cities in Massachusetts, with their aggregate population of 2,102,000. It would furnish them with 2,000 feet per capita per annum out of 2,245. And this is simply the *annual increase in the waste.*

THE FORTY LARGEST CITIES OF THE UNITED STATES AND THEIR POPULATIONS IN 1900 AS GIVEN BY THE WORLD ALMANAC.

		Brought forward,	11,971,152
Gr'ter New York, N.Y.	3,437,000	Indianapolis, Ind...	169,164
Chicago, Ills.........	1,698,575	Kansas City, Mo....	163,752
Philadelphia, Pa.	1,293,697	St. Paul, Minn......	163,065
St. Louis, Mo........	575,238	Rochester, N. Y.....	162,608
Boston, Mass........	560,892	Denver, Colo.	133,859
Baltimore, Md.......	508,957	Toledo, Ohio.......	131,000
Cleveland, Ohio.....	381,768	Allegheny, Pa......	129,896
Buffalo, N. Y........	352,387	Columbus, Ohio....	125,560
San Francisco, Cal. ..	342,782	Worcester, Mass....	118,421
Cincinnati, Ohio.....	325,902	Syracuse, N. Y......	108,374
Pittsburg, Pa.........	321,564	New Haven, Conn..	108,027
New Orleans, La.....	287,104	Paterson, N. J......	105,171
Detroit, Mich.	285,704	Fall River, Mass....	104,863
Milwaukee, Wis......	285,315	St. Joseph, Mo......	102,979
Washington, D. C....	278,718	Los Angeles, Cal....	102,479
Newark, N. J........	246,070	Scranton, Pa	102,026
Jersey City, N. J.....	206,433	Lowell, Mass.......	94,969
Louisville, Ky.	204,731	Albany, N. Y.......	94,151
Minneapolis, Minn...	202,718	Cambridge, Mass...	91,886
Providence, R. I.....	175,597	Portland, Ore.......	90,426
	11,971,152		14,373,828

Total population of forty largest cities in the United States, =14,373,828.

To further emphasize the extent of the present enormous waste of gas in coke making operations, and as a confirmation of the fact that I was well within bounds, in my previous figures in reference thereto, the following data is submitted, taken from another report of the U. S. Government, which was issued from the Department of the Interior, on "Illuminating and Fuel Gas and By products," by Mr. William B. Phillips, dated 1899, and giving results for the year 1898.

It shows that the returns from 433 gas companies in various States, sent in as called for by the Government, were as follows:—Massachusetts heading the list with 45 companies; New York State, and Ohio with 41 each; California and Illinois 26 each; Pennsylvania 22; Michigan 21; Indiana and Missouri 13 each, and so on.

The production of gas in these 433 cities and towns, is given in round figures as follows:

Coal gas	19,469	millions cubic feet.
Water gas	30,419	" "
Oil gas	497	" "
Total gas made	50,385	" " per annum.

The coal used in making the above quantity of coal gas was 2,042,698 net tons, showing an average production in coal gas of 9,531 feet per net ton. So that the coal used in coke making in the United States (as given by Mr. Parker at 30,219,343 net tons) is upwards of fourteen times as great in quantity as that used in coal gas making, in the 433 cities and towns just referred to. And the gas wasted therefrom (taking it at 4,000 feet per net ton, which could easily and profitably be recovered) would supply the 433 cities and towns with gas at their present total rate of consumption of coal, water and oil gas 2⅓ *times over;* which greatly exceeds my previous conservative calculations. When this gigantic stream of waste shall be converted into a stream of profit, as it will surely be in the not distant future, it will very considerably alter the present aspect of gas affairs in many sections of the United States. There have been some notable and costly experiences to gas companies in this country, in the past, and history has a remarkable tendency to repeat itself, especially along favorable lines; it will be well for us, as gas men, to do all in our power to use any new forces that may be developed along the lines of the industry in which we are all so deeply interested, rather than let them get away from us.

Another indication of the possibilities of the extension of the coke business; only recently the Erie Railroad Company has given out that it will abolish the use of soft coal on its passenger trains, out of consideration for the traveling public, and there can be no question but that such a step will remove one great discomfort in railway travel.

It can safely be predicted that other railroad companies will follow suit. In fact, one of the New England railroad companies has already, to a considerable extent, adopted coke as locomotive fuel. And when coke can be made and sold with a reasonable margin of profit, at considerably lower prices than hard coal, (except for the buckwheat and smaller sizes of anthracite, which until the last few years have been mostly waste) the coke business will grow.

That this enormous waste just referred to, can, and will eventually be avoided, is beyond question. In some parts of Europe the By-product Retort Oven has practically driven the beehive oven out of the field, because the fact has been so abundantly proven, that a considerably larger percentage of coke, from a given quantity of coal can be produced from the Retort oven than from the beehive, for the reason that in the beehive there is a large waste, partly by the admission of air, to burn the gases inside the oven, to heat the oven itself, and also in other ways that need not be detailed here; while the retort oven is externally heated, by a portion only of the gas produced, which is entirely wasted in the beehive; and to-day it is a great anomaly to find that this great progressive country has, in this respect, lagged so far behind other countries, by sticking to the old beehive oven. Fortunately for the great coke making industries of Pennsylvania, they have been so prosperous, and profits have been so satisfactory, that the savings to be effected by the recovery of the by-products, have hitherto been almost entirely ignored.

But the conditions of modern commercial enterprise and activities, make it impossible for such known waste to be permitted for very long.

As existing sets of ovens wear out, and renewals have to be effected, the shrewd and able men at the head of the coke business cannot afford to overlook the possibilities of improvement; nor are they likely to do so, because the matter is no longer one of doubt or question, but of abundantly demonstrated facts, the proofs of which are easily obtainable. And if they do ignore the matter there are others who will probably not be slow to take advantage of the opportunities presented.

The efforts being made in all progressive cities and towns for the suppression of the soft coal smoke nuisance is opening such a field for smokeless fuel, that with hard coal at present rates, it should create such a demand for vast quantities of coke as may, and probably will, change the factor of the problem from the gas to the coke side of the question, in the not distant future.

A very significant remark in the report of Mr. Parker, is as follows:

"There seems to be no reason to doubt that the by-product ovens will eventually supersede the beehive, at least in great part. The question as to whether the coke from these Retort ovens is the primary product or the by-product, is determined by the location of the plant, and the demands of the particular locality."

It seems to me quite safe to take a step further than this and say, that as coke for foundry and other purposes is used in all parts of the country, and has to be freighted there, from the centres of coke production, there is no reason whatever why the coal should not be freighted instead of the coke, to the centres where the gas and other by-products can be more readily and profitably disposed of. And therefore, as the use of the by-product oven is extended, as it will be, the gas aspect of the question must not be lost sight of by gas men, who must be prepared to meet the changing condition of the gas business due to the use of retort ovens for coke making.

The products from retort ovens are practically the same as from the ordinary retorts; analyses in the appended table abundantly prove that the gases from the oven and the retort are so similar in every respect, as to enable it to be said, that there is practically no difference between them; except that in the gas from the retort ovens, mainly on account of the larger mass of coal carbonized at a time, the longer periods of distillation, and the leaner coals generally dealt with, the illuminating power of the average

ANALYSES OF COAL GASES, AND GAS FROM SEMET-SOLVAY RETORT OVENS.

		Paris.	London Gas Light and Coke Co.	London South Metropolitan.	Liverpool.	Bristol.	Birmingham.	Leeds.	Nottingham.	Brighton.	Norwich.	Newcastle on Tyne.	Sheffield.	Average of the 12 foregoing.	Semet-Solvay Ovens.	Dr. E. G. Love.	
															With a 35% Volatile Coal.	Manhattan Coal Gas.	Harlem Coal Gas.
Reputed Ill. Power.	..	..	16	16	21½	17	17¼	18	18½	14	14	16	18	..	..	..	..
Carbonic Acid	CO_2	1.72	..	0.09	1.70	..	1.50	0.34	0.81	0.03	0.27	0.28	0.74	.69	1.3	..	1.08
Olefiant Gas; (or Illuminants).....	C_2H_4	4.94	4.41	2.92	7.90	4.58	4.76	7.28	5.63	3.76	3.26	3.62	6.28	4.94	3.4	6.38	6.31
Oxygen......	O	..	0.26	..	0.19	0.27	0.36	0.07	0.24	0.23	0.14	0.23	0.10	0.21	0.45	..	0.06
Carbonic Oxide	CO	8.21	3.75	4.11	3.39	4.77	4.05	5.02	5.63	4.14	3.40	3.37	4.72	4.54	6.0	6.31	6.14
Methane, or Marsh Gas	CH_4	35.03	37.64	36.55	44.28	40.70	39.	42.74	39.66	38.15	36.11	36.71	43.05	39.13	33.5	39.01	42.38
Hydrogen ..	H	50.10	47.99	53.14	36.44	44.57	40.23	40.23	45.52	51.62	53.79	50.50	43.05	46.46	50.45	45.79	46.53
Nitrogen	N	..	5.95	3.19	6.10	5.11	10.10	4.32	2.51	2.07	3.03	5.29	2.56	4.56	4.9	2.51	0.5
		100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.

NOTE.—The figures for the Paris and British Gas Companies are taken from Mr. Norton C. Humphry's "Chemistry of Coal Gas."

gas during the whole period of distillation, is not quite so high as that from the retorts; with coals of the same high percentage of volatile matter as ordinarily used in gas making, and with gas as a consideration, there is no reason why gas of quite as high illuminating power should not be obtained from ovens as from retorts.

The retort oven offers one great advantage from this standpoint over the retort, in that it permits a very simple and effective method of separating the gases at different periods of distillation, which is not practicable with the retorts and would be no advantage with them. Every gas man knows, that in coal gas making, the richer gases come off from the retorts in the first half of the charge; as a matter of course it also does the same from the ovens; and two separate hydraulic mains being provided the rich gases are taken off for lighting purposes and the later, non-illuminating portions which are of great heating value, are utilized for heating the retort ovens. Not only so, but as the gas from the latter half of the charge, contains a considerable portion of Benzene which has a very high illuminating value, this Benzene can be readily and economically extracted from the poorer gases that are to be used for heating and added to the richer portion set apart for lighting, enriching the latter to such an extent as to enable gas of say 20 candle power or over, to be obtained from a coal that, from the retort gas making standpoint, would be considered a very poor one, and scarcely worth the handling for gas making.

As the By-Product Retort Oven has been so frequently and so ably dealt with by others, from the standpoint of its construction, especially by Mr. W. H. Blauvelt, of the Semet-Solvay Company, whose excellent paper on that subject will be found in "The Mineral Industry" for 1895, and by the exhaustive work of Mr. John Fulton, whose treatise on "Coke and the saving of By-Products" contains a mine of information on the subject, and by many others, and the fact proven over and over again that coke can be produced at cheaper rates per ton in a retort oven than in a beehive oven, and how a retort oven will produce coke in 22 to 24 hours equal to the 72 hour production of the beehive oven, I need not deal further with that phase of the question. The subject has impressed itself on my mind more from the *gas* side of it than any other, because I realize what it means to the gas industry in the future.

I would here refer to the paper of Mr. Peter Young, presented to the

RETORT OVENS VS. RETORTS IN GAS WORKS.

Comparative Statement on Carbonizing Labor.

The data for the British Companies taken from Field's Analysis for 1900

	Gross tons Coal used.	Gas made in thousands.	Carbonizing Wages paid.	Carbonizing Wages per gross ton.	Carbonizing wages per net ton.
3 London Companies Totals and Averages	3,249,955	36,611,884	£523,377 = $2,548,846	c. 78.4	c. 70.
12 Suburban Companies, Totals and Averages	611,408	7,865,984	£97,537 = $475,005	77.7	69.3
9 Corporations, Totals and Averages	1,881,318	20,215,086	£257,900 = $1,255,973	66.7	60
8 Provincial Companies, Totals and Averages	1,063,823	11,751,466	£169,756 = $826,711	77.7	68.4
2 Scottish Companies, Totals and Averages	826,464	7,851,796	£125,968 = $613,464	74.2	66.2
Dublin	125,788	1,556,859	£23,095 = $112,472	89.4	79.8
Average of the above 35 Gas Companies and Corporations				77.3	69. = 3.4 times cost in ovens
U. S. Coal Gas Works...	....	....	... say . .	......	95. = 4¾ times cost in ovens
Semet Solvay Retort Ovens.......	....	....	....	......	20.

Ohio Association last year, to be found in the American Gas Light Journal of April 16, 1900, in which that gentleman gives 30 cents per ton of coal as the cost of carbonizing in retort ovens. I can say from actual knowledge of the facts, which I have daily observed for some months, that it is very much below that figure, viz., under 20 cents per ton—the coal handled per man employed (excluding foreman) is 12.8 tons per day, and the question of labor is a very important one. In this connection I refer to Field's Analysis of British Gas Companies Accounts, dated 1901, for year 1900, which shows that in 35 of the principal gas companies and corporations of that country, the cost of carbonizing wages are as follows, and shown in tabular form herewith, from which it will be seen that in

3 London companies, carbonizing wages = 70c. per ton (2,000 lbs.)
12 Suburban " " " = 69.3c. " "
9 Corporations, " " = 60c. " "
8 Provincial Companies, " " = 68.4c. " "
2 Scottish " " " = 66 2c. " "
Dublin, " " = 79.8c. " "

Average of the above 35 companies = 69., which is 3.4 times the cost in the United States in retort ovens, notwithstanding the higher rates paid for labor in this country. It is not an easy matter to get as full data as one would like, in this country, but from facts that I am acquainted with in various places, I think in view of the much higher rates paid to American workmen, that 95 cents per ton is about a fair average for carbonizing wages in the United States, and at this figure it would be 4¾ times the cost of carbonizing labor in retort ovens. These are simple cold facts.

The first retort ovens erected in this country, were erected in 1893 by the Solvay Process Company, at their works in Syracuse, N. Y., to produce the coke required to burn the vast quantities of lime used in one branch of that Company's business. The Company also required large quantities of ammonia, and ovens were put up primarily to supply those demands. Since then these ovens have been gradually developed for the recovery of all the by-products from the operation of coking coal, gas among others.

The Journal of Gas Lighting, in an essay (June 11th,) on "Coke Oven versus Gas Works Coal Carbonizing Plant" said, "All competent readers of the signs of the times in respect of the technicalities of Towns' gas production must agree, that the best and most advanced professional opinion is at the moment at a state of suspense on the question of what is to be the line of development of gas manufacture in the immediate future."

And it goes on to point out how the factors are gradually changing from the question of light units to heat units, and the great change that may be expected when the 1893 patents of the Welsbach Company expire in 1907. And the Journal, referring to some remarks made by one of our esteemed fellow members of this Association, says, " Mr. Egner starts by admitting as proven, that the by-product coke oven is a 'long way ahead' of older methods of coke manufacture; but this is precisely what the largest manufacturers of metallurgical coke in the United States, in the far famed Connellsville region, do not concede." Of course they do not concede it, neither could they be expected to concede it, for the simple reason that hitherto the Connellsville region and operators of that section have practically controlled the coke making industry, and they could not afford, especially at the present stage, to admit that coke made from other coal and by other methods than theirs, was as good as theirs; and *they never will admit it, while their product is beehive coke. But the users, the great steel and iron makers, are rapidly learning the facts*, and find that retort oven coke can be and is made in every respect equal to beehive coke, and cheaper. And it is no secret that the greatest obstacle, so far, to the introduction of retort ovens, has been the systematic endeavors of the beehive oven men to persuade foundrymen and others that retort oven coke was not as good as that from beehive ovens. The reaction will be all the stronger against the latter when the true facts are fully realized. (Some of us butted our heads against that kind of a stone wall on the water-gas question; and, while eating crow is certainly not as satisfactory as taking quail on toast, the opponents of the retort oven will sooner or later have to partake of the first named unpalatable dish, and it is on that line the battle has to be fought and won, as it will be.)

It is, I think, a mistake to assume that the gas is, under all conditions, the most valuable product of the coal. That is entirely a matter of conditions, and very largely a matter of locality. The beehive oven men evidently do not hold that view, because their methods prove that they consider not only the gas but the tar and ammonia practically valueless; and it may really be so under their conditions and methods of working, because their operations are too far from the gas market.

For generations past engineers have looked regretfully at the enormous power of Niagara Falls going to waste, and have figured what could be done with it if they only had it placed just where they wanted it. And it is only recently, as we all know, that practical effect has been given to the self-evident proposition, that it is easier to establish factories near Niagara than it is to remove the falls. May not an analogous condition be brought about in the coke trade to a large extent? When it is borne in mind, that as previously stated, the quantity of coal used in coke making in the United States, is fourteen times larger than that used in coal gas making in 433 cities and towns, and that not only is all the coke therefrom readily marketed, but the demand is increasing to such an extent as to necessitate the building of hundreds of additional coke ovens every year; and as a very large portion of the coke so produced is shipped to various parts of the country, it seems to me more a matter of decentralization of the coke industry than anything else. In localities where there are a considerable number of foundries, or where there can be established an opening for the coke for locomotive fuel, for general steam raising, or other purposes, it is to my mind a matter beyond question, that ovens can be operated to earn a larger percentage of profits on the outlay than retorts can.

If it is not possible to take the mountain to Mahomet, may it not be found possible to take Mahomet to the mountain; and further, may not Mahomet himself be much benefited by such an excursion? We cannot remove our towns and cities to the centers of coke production, but I see no reason why, to a large extent, the coke making should not be conducted at points where the byproducts can be more readily marketed with advantage to all interests concerned.

I have gone into this question of retort oven versus coal-gas retort very carefully during the last few months, and have taken it, I think, from all standpoints; and from comparisons of the actual work being done day by day in Semet-Solvay Retort Ovens, and of the very best average results I know of being obtained in the ordinary retort processes in gas works in both the United States and in Europe, and knowing as I think, whereof I speak, I am prepared to go on record with this statement.

In gas works of even moderate size, operating with retort ovens, and turning out a first class foundry coke for which there is a large demand at good prices, good substantial profits can be made, with gas at such prices as would be utterly and absolutely impossible for retort methods to compete with.

I have some carefully prepared statements which I think prove this beyond question, but as I think it undesirable in the interest of our business to give the details and figures for publication, I shall be happy to go through them with any member or members of this Association personally. When the retort oven, from the same quality coal, can put out 72 per cent. of its weight, in coke, against 66 per cent. in beehive ovens; do it every day in the week and every week in the year, and of equal quality, that and time settles the question from the coke standpoint. And when lean coals, with a low percentage of volatile matter, coals that are not usually classed as suitable for gas making can be used, and give off, *as a by-product*, 4,000 feet per ton, which is at present going to waste all over the country, to the extent of a supply, as shown, equal to 2⅓ times the quantity consumed in 433 cities and towns (as shown by the U. S. Government Report I have quoted), it will surely be evident to my brethren of the Gas Fraternity, that as "coming events cast their shadows before," it should be the policy, pleasure and profit of the gas men to grasp the substance as it comes along; and they can be trusted to do it, too.

WHAT IS THE BUSINESS OF A GAS COMPANY?

WRITTEN FOR THE TWENTY-NINTH ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION, BY FRANK D. MOSES, TRENTON, N. J.

To make permanent profits for its owners and render satisfactory services to the public in return. A Gas Company badly managed rarely does either. It is generally a burden to its owners and an indirect injury to like interests. It is easier to build a gas works and produce one million feet of gas, than it is to find a market for the same; therefore the most important end of the gas business relates to the sale of gas rather than to its production.

Perhaps the following experience will teach disappointed owners and managers of gas properties some ways of relief and improvement.

Some years ago the writer was employed to investigate and report, first, on the advisability of removing an old gas works to a new location. Second, whether the proposed plans for the proposed new works could be reduced in cost, and if so, how. One or two engineers had previously figured on the job, and submitted bids running between thirty and thirty-five thousand dollars. While thus engaged I saw much of the town, of its residences, stores and people, and was much amazed at the rarity of gas, and the abundance of oil and electric lights. Later I inquired about the number of gas ranges in use, and the reply was to the effect that they were so few it did not pay to bother with them, that none were kept in stock, never had been, and that when wanted they were obtained from another gas company in a near-by town, and sold to consumers at list price. I had already ascertained that the old works were not bad and had greater capacity than had been used. I grew suspicious, began to feel a deep sense of sympathy for that thirty or thirty-five thousand dollars that was to be invested for profitable returns under such unfavorable conditions, and concluded to investigate further on my own account

I found many streets with houses, but without gas mains; I found too, a pitiful per capita consumption and that the management of the company was exceeding great in everything that contributed to the minimum cost of gas, and exceeding small in everything that contributed to the maximum consumption of gas.

My report to the owners came near getting me into trouble, and very properly so as I nearly forgot to report on the specific subjects for which I had been hired, and dealt almost exclusively with subjects for which I was not hired. The works were not removed Only a few thousand of the thirty were put into overhauling and bettering the old works; more were put into extensions of gas mains, services, Welsbach lights and gas cooking and heating appliances, meters, etc., and within one year after these progressive steps had been initiated, the output and sale had doubled, and the works were still able to furnish more gas.

For aught I know the cost of gas in the holder may not have been quite as low as before; I am only sure the owners had forgiven my oversight of their original orders to me, and that they were making more money and congratulating themselves upon the reforms that had been introduced.

While recognizing the great need of minimum cost of gas, I wish to emphasize my conviction that that question is greatly overshadowed by that of increased gas consumption without which maximum profits cannot be realized out of the business.

It is a comparatively easy thing now-a-days to make gas economically; there are many able engineers to plan, and contractors to build and equip almost perfect gas works. There is also a good supply of engineers to run them, to teach assistants how to do it, and to introduce and maintain order and discipline in every department connected therewith.

In the commercial department of the gas business there is constant need of keen and aggressive business methods, and here I think there is sore need for improvement. When slow conservative policies and high prices ruled and the use of gas was practically limited to light, and to city consumption, the modern commercial spirit had no show, but the spirit of ill-will and distrust between the company and the consumer did have a show, and continues to plague the ambitious, up-to-date gas company.

While marked progress towards better commercial conditions and financial results has been made, much remains to be done in order to realize the great possibilities for profit and usefulness in the gas industry. Considering as I do future prospects brighter and usefulness greater than ever in the past, the work and thought devoted to this paper will be well paid for if I succeed in adding anything new or useful to a subject ably and frequently discussed before you in the past.

Taking it for granted that we all want to, and must sell more gas, that existing conditions call for lower and lower prices, and that these calls have been and will continue to be met successfully, I will confine myself entirely to fuel gas and its increased use by the public, through the efforts of the commercial department of the company.

My favorite example of that department is that of an enterprising, aggressive mercantile establishment, everlastingly advertising its wares, enjoying large patronage, favorably spoken of by everybody, making money and extending the establishment all the time. It may sell dry goods, or hardware, or anything else, while we only have gas to sell; still I believe that we have only to study the causes of its success, and apply its methods as far as practical to our business in order to reach a fair measure of the success which such establishments are enjoying.

The following rules represent the groundwork upon which I think the commercial department for selling fuel gas should be run.

First: I am Fuel Gas and have brought my industry from depression into prosperity and respect.

Second: Thou shalt not be close-fisted, or "penny wise and pound foolish." But thou shalt spread out my arteries to all people.

Third: Thou shalt not neglect thy opportunities to spread my merits, that the people may enjoy my blessings.

Fourth: Thou shalt provide my appliances unto my people, to the end that they may use them constantly and economically.

Fifth: Thou shalt not humiliate thyself, but thou shalt be active, intelligent and deliberate and tarry long among thy brethren.

Sixth: Thou shalt be indulgent to others who know less than you do, and treat them as brothers.

Seventh: Thou shalt make use of me in all seasons, for my virtues are everlasting.

Eighth: Remember thy bosses to make them happy and rich.

Ninth: Six days shalt thou labor in joy and watchfulness, that thou mayest be wise and earn thy bread.

Tenth: But the seventh day thou shalt not do any work, unless you have to.

I hope no one will accuse me of a lack of reverence in preparing these rules, and I am afraid they will not be clear enough unless I take a little time in explaining them, and with your permission I will do so.

First: Fuel Gas is recognized as a redeemer of the gas industry.

When the electric light appeared, owners of gas properties became frightened, and the value of gas securities depreciated. It was felt that electricity would encroach upon if not entirely supersede gas as a lighting agent; as a matter of fact it has encroached and continues to do so, as the percentage of gas used for lighting has not increased in fair proportion. But now gas securities have increased in value and popularity and, on an average, are worth more to-day and are of higher repute than ever before. Fuel gas is alone responsible for this happy situation. The people everywhere recognize the great utility of fuel gas. It has lessened drudgery and improved health. Through the improved method of production, the price of gas has been continually cheapened, so that the poor as well as the rich may use it. When its merits are understood it has challenged the respect of the people.

Second: Many owners of gas properties have refused to invest the funds required for modern betterments and extensions. They have failed to share in the enormous benefits which have come to others who have done so. They complain that they are not prosperous, yet they alone are probably responsible for it. Other companies having modern and efficient works have failed to extend the mains and services into streets along which are found many residents who would be only too glad to use gas if they could get it. Entirely too many gas people overlook the fact that profits are contingent upon ample facilities, and practical and constant efforts in the right direction. They forget that the larger the consumption, the cheaper the gas. They forget that it is possible to sell the entire capacity of a vast majority of gas works in this country, and that many of them, if the commercial department were properly managed, would be able to reach a point where the consumption could be maintained on a par with the production during the entire 24 hours.

Third: There are lots of people who do not know the value of gas for fuel purposes; those who have never used it as well as those who have. They must be taught all about it, either verbally, or through the daily papers or other printed matter. There are many ways of educating the people, by any one of the three foregoing methods. I wish simply to emphasize that whether one, two or all of the said methods be employed, they must be persistent and everlasting. One campaign or season is not sufficient, it must be repeated every season. Communities are very much like individuals; some are progressive, some are unprogressive; some are quick, some are slow; and with some the weather is more constant than with others. All the factors have their influence, and must be considered.

Fourth: Gas Companies should provide suitable, centrally located and attractive quarters for the exhibition of gas appliances. A bare, unadorned room detracts from the goods exhibited, whereas an attractive room improves them. They must provide gas appliances, for all kinds of domestic and mechanical purposes. The list includes for domestic purposes—gas ranges, heating, laundry and sad iron stoves, water heaters, etc. In the mechanical line, where the size and industries of the town warrant it, a sample gas engine may be profitably exhibited, and a large number of them can be sold if effective canvassing for their introduction is made. Appliances should be contracted for in good time, and carried in stock in goodly quantities. Samples should be kept shining and attractive. One of the most serious drawbacks to the popularity of gas as a fuel arises from the ignorance of the masses respecting its use. It is not so much the price of gas, but the service patrons get, that tells for or against the consumption. There is more profitable work to do among smaller than larger consumers, because the former are in the majority. Once a number of small households in a community begin using gas for fuel, its consumption increases many fold, and at compound interest. Inspection of all gas appliances in use should be made frequently, and at fixed periods. Inspectors should be selected with reference to their intelligence, their knowledge of gas appliances, and their ability to impart that knowledge to the user. Only by such methods will the latter realize the value of gas for fuel, and the other advantages connected therein. Once this has been accomplished, and not until then, may we expect gas to universally take the place of solid fuel, and good will take the place of ill-will.

Fifth: The manager or salesman need not humiliate himself, he can be dignified and firm always. He should be active in ferreting out every possible avenue for the sale of gas; considerate of everybody. He should be familiar with every branch of the gas business, whether in the manufacturing or commercial departments. He should be active and deliberate and never jump at conclusions "half-cocked;" many problems and difficulties arise that require careful study, and one should never be too sure that he is right until he understands his subject in all its bearings. He must be truthful so that his word shall be as good as his bond. If he tarries among his brethren he will attend the meetings of gas men, and pick up useful knowledge that he had not discovered in his personal experience. He should read gas literature, and post himself regarding the commercial methods of other companies, as presented through the trade journals and at the meetings of the gas men, and learn about every new appliance that may be put upon the market.

Sixth: He should be indulgent to those who know less than he does, and realize that consumers are not gas men and through their ignorance of the subject rather than malice, frequently say and do provoking things. It should be the manager's or salesman's aim to be cool and courteous, to explain all the facts and circumstances as he understands them, and the majority of complaints can in that manner be satisfactorily rectified.

Seventh: The gas for fuel should be used all the time, in winter as well as in summer. It is my conviction that we have paid too little attention to the use of gas for heating purposes, and that with proper efforts, gas heating stoves can be introduced to a greater extent than heretofore. I believe this because, if their use is well understood, the cost of gas will be as satisfactory as that of a cooking range.

Eighth: Remember the bosses. The meaning of this is obvious. Gas managers or salesmen have no desire to be pensioners of the Gas Company. They want to earn not only what they get, but a great deal more. If they earn more, it will be in the shape of dividends destined for the pockets of the stockholders. This I believe to be the desire, as it ought to be the ambition, of every man connected in an executive position with a Gas Company. If they succeed their lives will be made much happier, as they will get from the Company what they need for the proper conducting of the business, and better service and increased consumption can be realized.

Ninth: There can be no holiday for an efficient and truly successful gas manager or salesman. Each must work faithfully and ceaselessly every one of the six days set apart for that purpose. They must watch every opportunity, not only to make but to save money for the Company. Work should be done with pleasure and in good spirit. They will be wise if they remember all their past experiences, as it will be useful to them in the future. Having the assurance that duty has been done, the comforts which may be theirs will have been well earned.

Tenth: When Sunday comes work stops, unless some unusual occasion arises where the Company's interest would warrant exceptions. That day should be one of rest and consideration for the work to follow.

THE FUEL VALUE OF RESIDUALS.

WRITTEN FOR THE TWENTY-NINTH ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION, BY CHARLES F. PRICHARD, LYNN, MASS.

The difficulty of disposing of residuals at what seems fair prices is a problem which at one time or another has troubled all gas engineers. If the domestic demand for coke, or the demand for tar for concrete or for distillation slackens, or if the production of coke or tar is for any length of time more than is required by the usual demand, amounts quickly accumulate for which few works have sufficient storage capacity, even if it were true economy to store considerable quantities for any length of time.

The desire to get rid of the excessive stock is taken advantage of by the buyer if he learns of the situation, and it is not uncommon to find prices breaking to a low point, and sometimes to a point below the true value of the residual, if sold or used as a fuel. The price is quoted and the market is affected unfavorably even at a considerable distance.

During the past few years coke has been sold at a figure below its true fuel value. Coal tar has been sold at one-half what it would be worth for steam-raising purposes, while water-gas tar and coke breeze have been absolutely thrown away.

There exists a demand practically unlimited for coke, tar and coke breeze, for the purposes of steam-generation, at a good price, and a price which is determined by the current price of bituminous or steam coal; the market is capable of absorbing the comparatively small amount of fuel we have to offer without producing any effect upon the price of coal; therefore the current price of steam coal can be taken as a measure to determine the fuel value of residuals and to determine the limit of price below which we need not go.

In attempting some years ago to make a proper charge to our electric station for the coke, coal tar, breeze and water-gas tar consumed by it under the boilers, I was unable to find any data by which to determine their fuel value; an extended search to-day has not shown any such data—a few ultimate analyses of German cokes, one or two of German and English tars, a little guessing at breeze, and nothing on water-gas tar. The object of this paper is to place before you ultimate analyses of residuals which have fuel values, their fuel values based upon these analyses, their fuel values tested by calorimeter, and finally their fuel values obtained by burning large quantities of them and the methods employed.

These results may not be the best possible, because they were obtained not under test conditions, but in the actual running of an electric station with all the irregularities of actual work. On the other hand they are results which are being duplicated every day, and which can be duplicated by anyone with reasonable care, and consequently show a fair fuel value.

The user of steam is in the market to purchase evaporative results. The large users of steam know what results can be obtained from a pound of the various fuels in the market, and to compete in the open market we must be prepared to offer for substantially the same amount of money a quantity of our fuel sufficient to produce the same result; in order to do this we must know just what results our fuels are capable of producing, and we must be able to show the manner of using the fuel to produce the best results.

To select a standard against which to measure our fuels is no easy matter, because there is no coal which is common to the country, different localities having different coals, and because any one coal selected has a variety of values assigned to it by different experimenters who have analyzed or tested it. Prof. Gill, in his Gas and Fuel Analysis, quoting H. J. Williams, gives the following as approximately the percentage composition of bituminous coal:

Moisture	0.6
Carbon	80.5
Hydrogen	4.9
Oxygen	5.4
Nitrogen	2.1
Ash	5.8
Sulphur	0.7
	100.0

A glance through Poole's tables will show that this could not be considered an average of the bituminous coals found in the United States, as there will be found even in Pennsylvania coals, ash as high as 12.7, and sulphur as high as 3 or 4%. It can, however, be considered a fair statement of the average composition of what may be called the standard steam coals of the Middle and Eastern States, such as Georges Creek Cumberland, Pocahontas, New River, etc., as it agrees with the analyses of these as stated by various authorities. Your experience will probably agree with mine, that it is extremely difficult to purchase any first-class coal which will always run as well as this analysis would indicate.

Accepting it as a fair standard, to obtain its calculated fuel value, let us take the code of 1899 of the American Society of Mechanical Engineers, relating to the standard method of conducting boiler tests. This endorses Dulong's formula, slightly modified, for computing the total heat of combustion from an ultimate analysis, as given below:

$$\text{Heat units of combustion} = 14600\,C + 62000\left(H - \frac{O}{8}\right) + 4000\,S$$

in which C=Carbon, H=Hydrogen, O=Oxygen, S=Sulphur.

Applying this to the ultimate analysis of our standard, and we have 14,385 British Thermal Units, as the fuel value of one pound of bituminous coal, which can be purchased in the Boston market for $3.75 per ton of 2,000 lbs., and it will have a theoretical evaporative efficiency of

$$\frac{14{,}385}{966} = 14.8 \text{ lbs. water from and at } 212^\circ.$$

In practice it will fall below this, for reasons it is not necessary to go into here, and in the daily running of the boilers, in which were burned the residuals which we wish to compare with it, its efficiency was 9.8 lbs. of water from and at 212°.

Should it become necessary to dispose of surplus residuals, the relation which their evaporative efficiency bears to the evaporative efficiency of bituminous coal as indicated above, gives the relation which their selling value bears to $3.75 in Boston, or the current price in other localities; below this resulting price there is no occasion to go; above it we should keep if possible.

COKE.

The sale of coke for steam-raising purposes has been handicapped by the belief of steam users that it is injurious to boilers, a fact sufficiently disposed of by its continued use, day after day of 24 hours, by thousands of boilers. More seriously is it handicapped by the statements found in the technical publications, beginning with the early editions of Haswell, stating an evaporation per lb. coke of 6½ to 7½ pounds of water, and continuing down to the present day, when we find in recent publications of gas papers records of experiments conducted in one of the London gas works, giving an evaporation from and at 212° of 7½ lbs. water per lb. coke. This is much too low, and it is a matter of vital importance to us to correct it if it is wrong and place on record a true and higher value.

Analysis of Coke from a Standard Gas Coal.

Moisture	1.12
Volatile Matter	3.38
Ash	8.75
Carbon	86.75
	100.00
Sulphur	0.84

Applying the formula before used, and assuming the volatile matter to be hydrocarbon vapors with a value of 20,000 B.T.U., the fuel value of the coke would be 13,341 B.T.U. This calculated value agrees practically with the value as given by Clark, Hutton, Steavenson, Poole and others, and would give a theoretical evaporation of

$$\frac{13{,}341}{966} = 13.8 \text{ lbs. water from and at } 212^\circ.$$

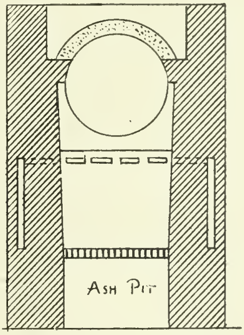
Calorimeter Test of Coke from a Standard Gas Coal.

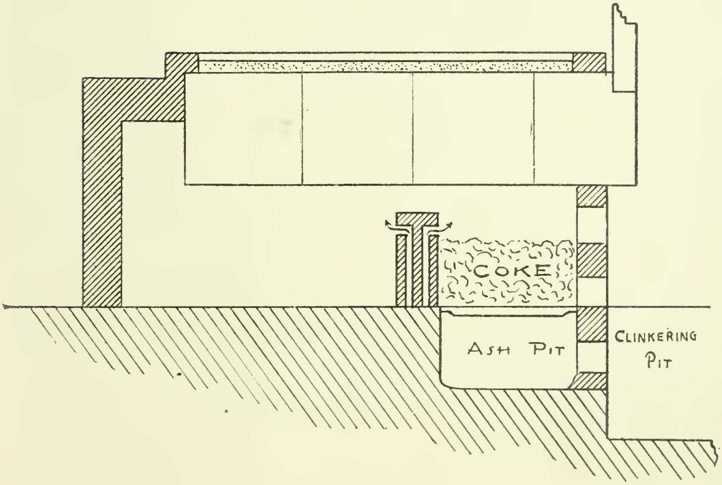
A calorimeter test of the above coke gave as its calorific power

13,469 B.T.U.

This is so near the efficiency of the best steam coal as given above that the question at once arises as to why coke has secured so poor a rating as a steam fuel, and if perhaps it is due to the conditions under which it has been burned, what changes should be made to secure the full benefit of the contained heat units?

In the extremely careful series of boiler tests of Barrus, I find two recorded tests made with coke from gas coal. One test shows an evaporation of 6.37 with coke, as against 6.96 with Cumberland coal. This test, however, was made with a plain cylindrical boiler, and under adverse conditions; the other test gives a better rating of coke as 9.66 against 11.33 for Cumberland, a better evaporation per pound, but poorer relatively.





Our own work at first showed similar results, the evaporation from the coke being from 10% to 15% below that of coal used under the same boiler and under the same conditions, being especially low when the boilers were even approximating their rated capacity. It was argued that much of the falling off was due to the thinness of the fire, which operated particularly against the coke on account of the open character of the fuel bed due to the relatively large size of the pieces, resulting in much more than the ordinary excess of air and consequently in low evaporation.

To remedy this, furnaces were constructed as shown in the sketch on the preceding page.

A bed of fuel some 2½ to 3 feet is run, the distance from grate to boiler being 4 feet or over; the area of grate is 25 feet, about 5 ft. x 5 ft. in dimensions. The brick walls on each side of the fire-box are hollow, and air is admitted to them at the bottom of the boiler front through small air ports. This air passes out through narrow slots on the fire-box side of the bridge wall, near the top. The walls of the combustion chamber are hollow and air from the rear is similarly admitted to openings in the rear of the bridge wall as shown. Air supplied through bridge-wall openings has long been credited with showing a small percentage of saving with bituminous coal, but with a gas furnace it is of course a necessity.

One side of the grate is fired at a time, and the times of firing are much less frequent than usual; the fire is clinkered once each day of 24 hours, usually in the morning. The work of firing is easier than with the ordinary grate and soft coal, repairs are small and no trouble has been experienced in any way. The amount of work done by the boiler is materially increased and the evaporation as shown by the table below is scarcely to be distinguished from the Cumberland coal; in fact we now consider there is no difference, pound for pound, in the results obtained.

The results presented are per lb. coal taken from an out-of-doors coal pile, the coal from year to year being often of different kind and price. The results show the variation incident to the variable hours, seasons, weather, coals, load, etc., which naturally come in the operation of an electric station of some 2,500 h. p.

Date.		Coal Used. Pounds.	Coke Used. Pounds.	Water Evaporated. Pounds.	Evap. per lb. Fuel.	Evap. fm. & at 212°.
Sept.,	1894	521,770	......	4,697,513	9.0	9.7
Oct.,	"	444,965	176,625	5,407,833	8.7	9.4
Nov.,	"	526,825	116,860	5,728,816	8.9	9.6
Dec.,	"	420,200	241,360	5,821,728	8.8	9.5
Jan.,	1895	461,305	240,910	6,109.270	8.7	9.4
Feb.,	"	288,610	328,735	5,000,495	8.1	8.7
Mar.,	"	505,955	147,970	5,558,362	8.5	9.2
Apr.,	"	561,810	......	4,583.061	8.1	8.7
May,	"	375,430	200,290	4,893,620	8.5	9.2
June,	"	500,270	......	4,452,403	8.9	9.6
July,	"	501,350	......	4,411,880	8.8	9.5
Aug.,	"	536,700	......	4,883,970	9.1	9.8
Sept.,	"	329.484	248,766	5,030,775	8.7	9.4
Oct.,	"	547,170	84,010	5,491,266	8.7	9.4
Nov.,	"	474,570	192,720	5,538,507	8.3	8.9
Dec.,	"	393,060	340,560	5,942,322	8.1	8.7
Jan.,	1896	580,380	124,880	5,853,658	8.3	8.9
Feb.,	"	376,690	304,520	5,722,164	8.4	9.1
Mar.,	"	647,240	......	5,760,436	8.9	9.6
Apr.,	"	560,645	......	5,045,805	9.0	9.7
May,	"	516,095	......	4,799,683	9.3	10.0
June,	"	490,600	......	4,317,280	8.8	9.5
July,	"	508,090	......	4,725,237	9.3	10.0
Oct.,	"	396,410	287,745	7,046,797	10.3	11.1
Nov.,	"	388,260	304,470	7,086,246	10.2	11.0
Dec.,	"	591,560	172,880	7,644,400	10.0	10.8
Jan.,	1897	466,650	301,250	7,525,420	9.8	10.6
Feb.,	"	657,280	......	6,112,704	9.3	10.0
Mar.,	"	422,500	266,180	6,749,064	9.8	10.6
Apr.,	"	345,590	253,690	5,992,800	10.0	10.8
May,	"	558,620	16,440	5,635,588	9.8	10.6
June,	"	545,540	......	5,400,846	9.9	10.7
July,	"	563,970	......	5,583,303	9.9	10.7
Aug.,	"	637,370	......	6,309,963	9.9	10.7
Sept.,	"	545,170	115,570	6,146,660	9.0	9.7
Oct.,	"	492,880	260,540	7,458,580	9.9	10.7
Nov.,	"	506,910	262,070	7,305,310	9.5	10.2
Dec.,	"	592,720	258,810	7,748,923	9.1	9.8
Jan.,	1898	654,010	143,830	7,579,480	9.5	10.2
Feb.,	"	364,960	240,970	5,513,963	9.1	9.8
Mar.,	"	438,660	259,340	7,631,000	9.5	10.2
Apr.,	"	407,700	187,610	5,536,383	9.3	10.1
May,	"	625,560	......	5,942,800	9.5	10.2
June,	"	553,510	......	5,258,345	9.5	10.2

Date.	Coal Used. Pounds.	Coke Used. Pounds.	Water Evaporated. Pounds.	Evap. per lb. Fuel.	Evap. fm. & at 212°.
July, 1898	564.380	......	5,305,172	9.4	10.1
Aug., "	461,100	176,125	5,671,302	8.9	9.6
Sept., "	483,490	185,290	5,952,142	8.9	9.6
Oct., "	756,190	......	6,705,700	9.0	9.7
Nov., "	620,290	182,740	6,745,452	8.4	9.1
Dec., "	643,020	309,110	8,093,105	8.5	9.2
Jan , 1899	838,840	32,870	7,757,219	8.9	9.6
Feb., "	733,020	.....	6,450,376	8.8	9.5
Mar., "	650,230	155,400	7,008,981	8.7	9.4
Apr., "	660,500	37,720	6,074,514	8.7	9.4
May, "	628,030	2,290	5,609,848	8.9	9.6
June, "	525,160	12,980	5,004,702	9.3	10.0
July, "	647,550	5,500	5,877,450	9.0	9.7
Aug., "	727,820	......	6,695,944	9.2	9.9
Sept., "	758,090	......	6,519,574	8.6	9.3
Oct., "	867,750	......	7,462,650	8.6	9.3
Nov., "	904,770	......	7,871,499	8.7	9.4
Dec., "	1,026,490	......	9,033,112	8.8	9.5
Jan., 1900	1,099.040	......	9,231,936	8.4	9.1
Feb., "	900,600	......	8,195,460	8.1	8.7

A test made with coke alone resulted as follows:

Duration of Test. Days.	Coke Used. Pounds.	Water Evaporated. Pounds.	Evap. per lb.	Evap. from and at 212°. per lb.
10	74,200	713,897	9.62	10.39

Theoretically our coke should not quite equal the standard selected of the best bituminous coal; practically, whether from a better furnace or because the coal as bought does not average as well as our selected standard, pound for pound gas coke in our practice equals the best bituminous coal, in other words, coke with us is worth $3.75 per ton of 2,000 lbs., and at 40 lbs. per bushel is worth 7½ cents per bushel for the purpose of replacing bituminous coal.

BREEZE.

ANALYSIS OF BREEZE FROM THE COKE OF A STANDARD GAS COAL.

Moisture	1.42
Volatile Matter	6.36
Ash	15.03
Carbon	77.19
	100.00
Sulphur	0.92

Calculated as before, it would have a theoretical evaporative power,

B.T.U. per lb. 12,541

Corresponding to an evaporative efficiency of

12.9 lbs. water from and at 212°.

CALORIMETER TEST OF THE BREEZE FROM A STANDARD GAS COAL.

Tested by the calorimeter the result was:

B.T.U. per lb. 12,699

The only statement I have been able to find of the evaporative results obtained from breeze from gas coke is given by Hutton, who states it at from 6½ to 7½ lbs. of water per lb. from and at 212°. This must mean theoretical evaporative power; as he states elsewhere its power to be 6762 B.T.U. equal to 7 lbs. water from and at 212°.

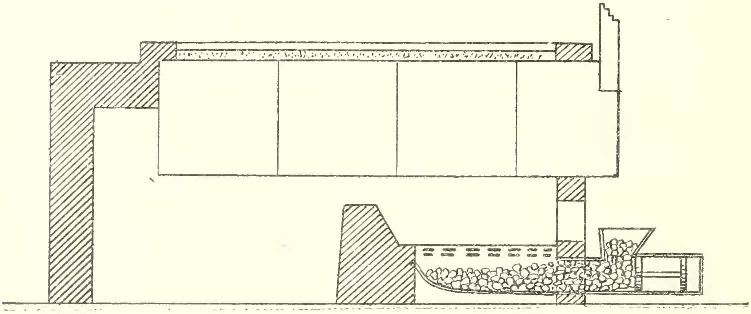
There is considerable difficulty in obtaining good results in boiler-firing with breeze; large quantities are liable to pass unconsumed through the grate, or with a strong draft over the bridge wall. The best results are obtained by burning ⅓ to ½ coke breeze with bituminous coal; this can be done successfully on an ordinary grate. Several tons sent to local steam plants were reported on as being equal to wharf dust from anthracite, which sells at $2.00 to $2.25 per ton of 2,000 lbs.

At the conclusion of the ten days' test of coke in the deep furnace referred to, another test of ten days was made under precisely the same conditions, except that about 1/5 breeze was added, fired in small quantities on top of a full fire, with the following results.

Used Coke.	Used Breeze.	Water Evap.	Evap. by Coke Est. 9.62 per lb.
68,795	14,090	736,038	661,807

Evap. by Breeze balance.	Evap. per lb. Breeze.	Evap. per lb. from and at 212°.
74,231	5.27	5.69

From Sept. 29 to Oct. 3, 1901, a series of tests were made with a boiler fed by means of an underfeed automatic stoker, with a mixture of coal and coke breeze in varying proportions. The sketch below shows the method of firing, and the table shows the results obtained. The evaporation of the coal is obtained by assuming that the average evaporation of 9.25, obtained from the coal used, immediately before and after the test, would be true during the test.



Date.	Reynoldsville Coal. Pounds.	Breeze. Pounds.	Water Evap. Pounds.	Evap. by Coal. Estimated.	Evap. by Breeze.	Actual Evap. per lb.	Evap. fm & at 212°
Sept. 29	5,260	1,340	55,220	48,655	6,565	4.9	5.3
" 30	6,000	2,000	68,747	55,500	13,247	6.6	7.1
Oct. 1	4,280	4,280	65,569	39,590	25,975	6.0	6.5
" 2	2,300	4,000	46,719	21,275	25,444	6.4	6.9

Average evap. 6.5

Previous tests made by the stoker people showed an evaporation of 7.02 lbs. water from and at 212°.

Comparison with our assumed standard, taking the evaporation 6.5 lbs. water as being an average, would result as follows :

Evap. Coal Evap. Breeze Cost Coal
9.8 : 6.5 = $3.75 : value breeze
Value breeze = $2.48 per 2,000 lbs.

It will be seen that the evaporative results are below what would be expected from its calculated power, and undoubtedly this is due to unconsumed carbon in the ash and clinker, and escaping in sparks, etc.; probably better results still may be obtained.

COAL TAR.

I do not find anywhere tests or other data bearing on the fuel value of coal tar, nor could I find ultimate analyses of tar from which to compute the fuel value; in fact the only analysis I have been able to find is one given in Mooney's Hand Book, as follows:

Carbon	92.0
Hydrogen	5.3
Oxygen	1.4
Nitrogen	0.3
Sulphur	0.2
Ash	0.8
	100.0

To determine this point I had a sample of the coal tar used in this test carefully analyzed and calorimeter tests made. The sample was taken from the tar as used; it was allowed to stand in a bottle surrounded by hot water till all the water which would separate by heat rose to the surface; this amount was estimated at 2%. The sample to be analyzed was taken from well below the surface, and gave the following result:

Analysis of Coal Tar from a Standard Gas Coal.

Carbon	89.21
Hydrogen	4.95
Nitrogen	1.05
Oxygen	4.23
Ash	trace
Volatile Sulphur	0 56
	100.00

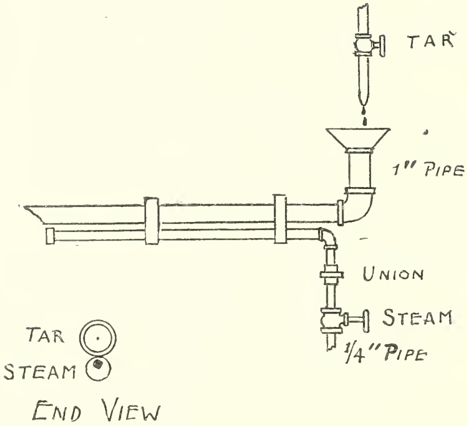
Specific gravity, 1.24.

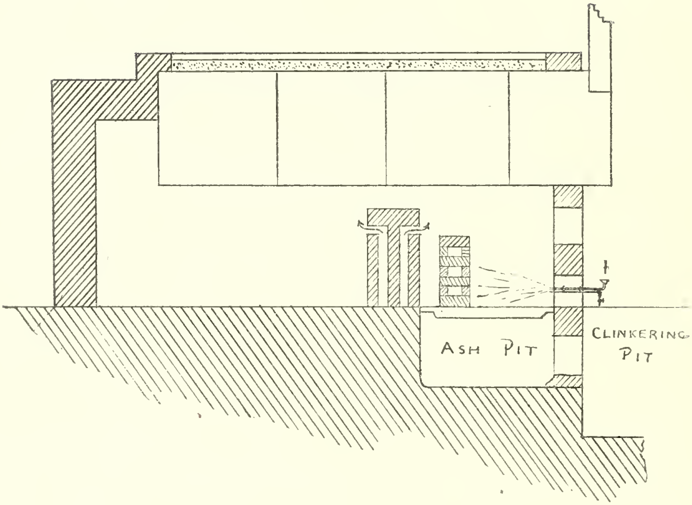
Its calorific power in British Thermal Units, as calculated, is

15,781 B.T.U.

Its evaporative power from and at 212° would be

16.4 lbs. water





CALORIMETER TEST OF COAL TAR FROM A STANDARD GAS COAL.

A careful test of its calorific power was made in a bomb calorimeter, and the value obtained was

15,708 B.T.U.

Tests were made in the same boilers with deep furnace, giving large combustion chamber, using a steam-jet burner shown in sketch. This burner is on the ordinary atomizer principle, the steam aperture being about $\frac{1}{16}''$ diameter, and using about 1% of the steam generated by the boiler; it works perfectly, with a minimum of trouble, and the tar is burned with a clear white flame, and without the use of a coal bed; it is simply thrown against a checker brick wall from two jets, one on each side of the center line of the boiler front at the level shown on sketch. No air is admitted except through the 6 inch square hole around each nozzle.

The results of the tests are as follows:

Date.	Coal Tar. Pounds.	Water Evap. Pounds.	Evap. per lb.	Evap. from and at 212°.
Sept. 20, 1901	2,180	24,634	11.30	12.20
" 21, "	2,140	23,754	11.10	11.98
" 22, "	2,100	23,520	11.20	12.09
" 23, "	1,625	16,650	11.25	11.07
" 24, "	1,500	16,980	11.32	12.22
			Average	11.91

I am sorry to say that I do not consider this test of the series a success, either in evaporation per lb. of tar, or in quantity of water evaporated in the boiler. I believe an evaporation of 14 lbs. can be easily obtained with full duty for the boiler. Various things conspired against the success of the experiment, and the limited time at my disposal, combined with the fact that we are selling tar at a price far above its possible fuel value, led me to postpone further experimenting till a more favorable time.

Comparison with our assumed standard, taking the evaporation at 11.91, would result as follows:

Evap. Coal Evap. Tar Cost Coal.
9.8 : 11.91 = $3.75 : value tar.

Value tar = $4.55 per ton tar.

Weight of barrel of 50 gallons Tar 516 lbs.
Value " " " $1.17.

If, however, we assume an evaporation of 14 lbs. per lb. tar, its value becomes per barrel of 50 gallons,

$1.38.

WATER GAS TAR.

I was unable to find any data regarding the use of water-gas tar as fuel, or any ultimate analysis from which it could be computed. It was therefore necessary to have an analysis made, and I give below the results of careful analysis and calorimeter tests.

The tar used comes from gas oil used in a standard Lowe set. The tar from the set is run to a tar tank having a capacity of some 500 barrels. The hot water from the seal and washer is sufficient to maintain the contents of the tank at about 135°. When the accumulation in the tank has reached a hundred barrels or so it is pumped from the bottom and burned without further separation.

In the sample taken from the regular boiler supply, about 2% of water separated by further heating in a vessel immersed in hot water.

ANALYSIS OF WATER-GAS TAR FROM GAS OIL.

Carbon	92.70
Hydrogen	6.13
Nitrogen	0.11
Oxygen	0.69
Ash	trace
Volatile Sulphur	0.37
	100.00

Specific Gravity 1.15.

Calorimeter Test of Water-Gas Tar from Gas Oil.

The heating value as determined by a bomb calorimeter was

17,193 B.T.U.

equivalent to an evaporation from and at 212° of

17.8 lbs. water.

The heating value as determined by calculation from the analysis in the manner before referred to was

17,296 B.T.U.

equivalent to an evaporation from and at 212° of

17.9 lbs. water.

Large quantities of the tar have been burned as it accumulated, and the results have been better, as we became more familiar with its use. It has been burned in the furnace and with the burner before referred to. It is more easily handled than the coal tar, being more liquid, and has less tendency to form carbon. It burns with a clear white flame, with no smoke or deposited carbon.

The following table shows the result of the latest test.

Date.	Pounds Tar Used.	Pounds Water Evap.	Evap. per lb. Tar.	Evap. from and at 212°.
August 28......	3,000	36,360	12.12	13.08
" 29......	4,260	56,400	13.21	14.26
" 30......	4,110	53,100	12.94	13.42
" 31......	3,960	57,120	14.42	15.57
September 1....	4,890	63,570	13.	14.24
" 2....	3,990	56,820	14.24	15.37
" 3....	4,335	56,222	13.20	14.25
" 5....	3,540	45,540	12.72	13.73
" 6....	4,770	70,440	14.76	15.94
" 7....	4,500	65,776	14.61	15.77
" 8....	2,130	31,950	15.	16.20

Average evaporation 14.9

Crude Petroleum, with a composition of

Carbon	84.00
Hydrogen	13.75
Water	2.25
	100.00

would have a fuel value by calculation of 20,789 B.T.U. Poole states American oil as having values from 18,000 to 21,000 B.T.U. equivalent to an evaporation of from 18.5 to 21.5 lbs. water. Barrus in his Boiler Tests gives the results of three experiments as 11.96, 13.66, and 15 lbs. from and at 212°. From this comparison of theoretical and practical values, it would seem as if the water-gas tar was being well utilized.

Its value compared with our assumed standard would be found as follows :

Evap. Coal Evap. Tar Price Coal
9.8 : 14.9 = $3.75 : value tar.

Value tar = $5.70 per ton.

Weight of barrel of 50 gallons water-gas tar, 479 lbs.
Value " " " " " $1.39.

SUMMARY.

It would appear from the theoretical and practical results cited above, that if steam coal is selling for $3.75 per ton of 2,000 lbs., a fair market value for fuel residuals would be :

Coke, per ton,	$3.75
Breeze, "	2.48
Coal-gas tar per barrel of 50 gallons,	1.38
Water-gas " " "	1.39

If the price of steam coal varies, the value of the residual would also vary; but with the broad market at our door, there is little reason for going below this price.

In Memoriam.

⁂

"'They rest', we said, 'their sleep is sweet.'"

⁂

WILLIAM G. ABEL,
Atlanta, Georgia.
Died December 21st, 1900.

ALFRED C. GANDEY,
Lambertville, New Jersey.
Died December 30th, 1900.

HAROLD HUMPHREYS
New York, N. Y.
Died February 12th, 1901.

DAVID W. CRAFTS,
Northampton, Massachusetts.
Died March 12th, 1901.

CHARLES C. FRY,
Lynn, Massachusetts.
Died March 21st, 1901.

WILLIAM STACEY,

Cincinnati, Ohio.

Died June 17th, 1901.

JAMES SLADE,

Yonkers, New York.

Died June 18th, 1901.

GEORGE B. NEAL,

Charlestown, Massachusetts.

Died July 7th, 1901.

WILLIAM E. BARROWS,

Philadelphia, Pa.

Died July 30th, 1901.

WM. W. GOODWIN,

Philadelphia, Pa.

Died October 6th, 1901.

⁂

"My own dim life should teach me
That this life shall live for evermore."

WILLIAM G. ABEL.

BORN December 10th, 1842. DIED December 21st, 1900.

William G. Abel was born at Gochsen, Würtemburg, Germany, in which country he received his education and spent the years of his boyhood and youth. At the age of 23, however, he went to France and worked as a draughtsman, at the same time attending the Polytechnic schools in the evening to fit himself for advancement. In 1869 he was in the employ of a Bordeaux firm which was building two gunboats for the Turkish Government, and when the vessels were completed he was selected by the firm to deliver them to the Turkish Naval authorities at Roustchouck. At this time he was also engaged on a portion of the plans for the first submarine boat ever built.

In 1870 Mr. Abel came to the United States planning a stay of a few months only, but he took a fancy to this country and decided to make it his home. After a short term of employment as a draughtsman in New York City, he went into business as a fresco painter. In 1872 he removed to Indianapolis to take a position with the Eagle Machine Works, but left this company a few months later to become Assistant Superintendent of the Indianapolis Gas Company, with which company he remained until July 1878, when he became Superintendent, Secretary and Treasurer of the Chattanooga Gas Company. After a stay of nearly five years in Chattanooga he was given the position of Superintendent of the Atlanta Gas Company, going to Atlanta in April 1883. When The United Gas Improvement Company came into complete control of the gas situation there he was made Manager for them. In 1897, owing to failing health, he was made Resident Engineer, which position he held until his death.

His long periods of residence in France and the United States enabled him to become almost as thoroughly conversant with French and English as he was with his mother tongue, German. He possessed also a well educated taste for music of which he was very fond.

Mr. Abel was elected to active membership in the American Gas Light Association October 20th, 1886, and though he took no very active part in its affairs and of late years had been unable to even attend the annual meetings, was well known to many of the members.

ALFRED C. GANDEY.

Born, 1846. Died December 30th, 1900.

Alfred C. Gandey was born in Brighton, England, but came to the United States with his parents when seven years old. After graduating from the High School in Lambertville, N. J., he served his time as a machinist's apprentice in Philadelphia and having become a thoroughly competent machinist returned to Lambertville to take a position in the shops of the Belvidere and Delaware Railroad Company. This he soon gave up to become the head machinist of the Lambertville Rubber Company. At the age of thirty, however, he went into business on his own account, purchasing a hardware store at No. 31 Bridge Street, in which location he carried on a successful business until his death.

Energetic in all that he undertook he soon added to the hardware business that of a Plumber and Gas and Steamfitter, which in connection with his business ability led to his appointment as Superintendent of the Lambertville Gas Light Company.

In spite of the demands made upon his time by his own business and that of the gas company, Mr. Gandey was able to serve the public in many ways. He was interested in all public institutions, charitable and otherwise, and was a member of several secret societies, and also of the Lambertville Fire Department. In 1897 he was elected a member of the Board of Freeholders of Hunterdon County, and upon its organization was made chairman of the Finance Committee, although the majority of the Board were Democrats while he was a Republican, and performed his duties so well that he was retained in the position throughout the full term of three years for which he was a member of the Board. In 1900 he was the Republican nominee for State Senator from his county, but, although he made a good fight, he could not overcome the strong Democratic proclivities of the district.

Mr. Gandey was elected an active member of the American Gas Light Association October 21st, 1891.

As was befitting for a man who had taken so active and energetic a part in the life of his town, the funeral services were largely attended. His good judgment and advice, which were always sought when any project of a public character was under consideration will be greatly missed in the future.

HAROLD HUMPHREYS.

BORN November 1st, 1877. DIED February 12th, 1901.

Harold Humphreys was born at Bergen Point, New Jersey, but as his parents removed to Philadelphia when he was seven years old, his preparatory school work was carried on in the latter city. As the time for his entrance into college approached an aptitude for mechanical subjects became apparent and in accordance with his own choice it was decided that he should prepare for Stevens Institute, which he entered in 1895 as a member of the Class of 1899.

Immediately after graduation he began work in the New York office of Humphreys & Glasgow, the intention being that he should be given the training necessary to fit him to become his father's personal assistant. As a part of this training it was planned that he should spend a year, beginning in March 1901, as an assistant on the construction work being done by the firm in England under the direction of the London office.

Having been married in the latter part of December 1900 he and his bride as a part of their wedding trip accompanied Mr. A. C. Humphreys and his family on a trip to Egypt and up the Nile, after which the party were to go to England together, and then break up, Mr. and Mrs. Harold Humphreys remaining in that country and the others returning to the United States. But while on the return journey down the Nile he lost his life in an attempt to rescue his younger brother who had fallen overboard while playing on the deck of the steamer, both being drowned before the steamer's boat could reach them.

Elected an Associate member of the American Gas Light Association October 18th, 1899, at the meeting over which his father presided, Harold Humphreys gave proof of his energy and willingness to be of service by the assistance he rendered to the Secretary whenever or however called upon throughout the meeting, assistance which was repeated at the Denver meeting a year later. Those of the members of the Association who had the opportunity to become well acquainted with him during the trip from New York to Denver on the way to this meeting felt that his career as a gas engineer was destined to be a worthy sequel to his previous success at college. They were also able to see something of the close companionship that existed between father and son and were thus enabled to better appreciate the full force of the blow suffered by the father from the sudden and tragic death of the son, as well as to feel a more personal sense of loss from this death.

Although the chosen work of a gas engineer had been only just begun, the future was full of promise of achievements of value to the profession, which can ill afford the loss of such a recruit. But while sorrowing for our loss we cannot help but feel that for him there has been no loss, for, to quote a classmate and close friend, he "ended a noble life in a still more noble death; a death of sublime self-sacrifice, for truly 'Greater love hath no man than this, that a man lay down his life for his friends.'"

DAVID W. CRAFTS.

Born February 17th, 1820. Died March 12th, 1901.

David W. Crafts was born at Whately, Mass., a direct descendent of an old Puritan family which came to America in 1630. His grandfather was a soldier in the Revolutionary war.

Mr. Craft's early life was spent in the place of his birth and in the adjacent towns Northhampton and Holyoke. At the age of 23 he went to Boston and was prosperously engaged there for a short time as a hair dresser, but finding that the climate did not agree with him he returned to Northampton and went into business in that place. When the Northampton Gas Light Company was organized in 1857 he was made President and held this position until 1861, when he took that of Superintendent, still remaining on the Board of Directors. As Superintendent he was the active manager of the company until his death.

Although fortunate in being able to celebrate with Mrs. Crafts their golden wedding in 1891, his wife and their three children all died before him.

He was prominent in the Masonic circles of Northampton and the state of Massachusetts, was a member of other secret societies and was also for many years a vestryman and warden of St. John's Episcopal Church.

He joined the American Gas Light Association in the early years of its organization having been elected a member October 20th, 1875, and was also a member of the New England Association of Gas Engineers. He was quite regular in his attendance at the meetings of the American Association until declining years made it difficult for him to travel. His death narrows still more the constantly decreasing circle of the older members who brought the Association through the years of infancy into a vigorous youth and manhood.

CHARLES C. FRY.

Born May 22nd, 1842. Died March 21st, 1901.

Charles C. Fry was born at Lynn, Mass., and spent his whole life there. His education was carried on in the public schools of his native city and ended with his graduation from the High School. After leaving school he began work in the shoe business. Although little more than a boy when the Civil War began, he joined a drill club in 1861 and when the Club became in 1862 Company I of the Eighth Regiment Massachusetts Volunteers he went out as a private in this regiment, but was advanced to the rank of corporal before he was mustered out in 1863. Resuming his business career he became in time a manufacturer.

His connection with the gas business began in 1880 when he entered the service of the Lynn Gas Company as Clerk and Treasurer. When the company was reorganized into the Lynn Gas and Electric Company he was made General Manager in addition to the offices previously held, and much of the success of the company has been due to the able manner in which he performed the duties of his position. At the same time he found leisure to do good service in connection with the Massachusetts Volunteer Militia and the City Government of Lynn.

His work with the militia began almost as soon as he was mustered out of active service in the army, since he joined it in 1864. His service was practically continuous from that time until he retired in 1897. His first rank was that of Sergeant, but in a year he was advanced to First Lieutenant. Later he was made Quartermaster,and then Adjutant of the Eighth Regiment. In 1876 he was made Major of the Seventh Battalion and after the disbanding of the Battalion was appointed to his old position of Adjutant of the Eighth Regiment, from which he was advanced to be Assistant Adjutant General with the rank of Lieutenant Colonel. When he retired he was appointed Brigadier General on the retired list.

His service with the City Government embraced terms as City

Auditor and City Marshal and then after a long interruption a service of three years in the Common Council, during two of which he was President of that body, and one almost as long in the Board of Aldermen, of which he was President at the time of his death. During these terms of office he served on important committees especially that of Finance and rendered valuable services to the community, the confidence of which he possessed in the highest degree owing to his unquestionable honesty and sincerity and his willingness to sacrifice his personal convenience to the demands of public duty.

In addition to these activities he was very prominent as a Mason and a Knight Templar.

Elected an active member of the American Gas Light Association October 17th, 1883, General Fry was a regular attendant at all its meetings and well known to many members for whom he always had a cheerful greeting. His death left a great gap in the ranks of the New England gas men as well as in the public life of his native city.

WILLIAM STACEY.

BORN 1840. DIED June 17th, 1901.

William Stacey was born in London, England, but as the family came to the United States and settled in Cincinnati when he was eleven years old his education was received in the schools of that city. When through with school he started work with the firm of Geo. Stacey and Company, which has since become the Stacey Manufacturing Company, the business being then as now the construction of apparatus for gas works. For many years Mr. William Stacey followed this work, during the course of which he was in charge of the construction of gas works in almost every state in the Union, and became quite an expert in gas holder construction especially. His advancement in the firm and the company succeeding it was steady and after a long term as Vice-President he was elected President in July 1900.

He was elected to active membership in the American Gas Light Association October 19th, 1887. The travelling necessitated by his long service in the active superintendence of construction work as well as his regular attendance at the meetings yielded him a wide acquaintance and many friends among the gas men of the United States. These friends knew him as a man with a warm heart and abounding in kind and loyal friendship, and received the news of his death with keen sorrow.

JAMES SLADE.

BORN 1835. DIED June 18th, 1901.

James Slade was born in Bath, England, and his early education was obtained in that country. At the age of 21 he came to the United States, settling first in Lynchburg, Va., but soon removing to New York City where he learned the trade of a carpenter. In the course of his work in this trade he was employed to build a fence for the Yonkers Gas Light Company and while on the job, made such a favorable impression on the then Superintendent, Mr. Wm. R. Beal, that he was offered the position of Works' Foreman, which he accepted.

With the company, into the employ of which he entered in this, as it might be called, accidental way, he remained until his death. After two years' service as Works' Foreman he was made Superintendent and later a Director as well, and when Mr Beal left the company for new fields of usefulness Mr. Slade became the active manager of its affairs. Its course was not always over smooth seas, as competing companies and a fire that badly damaged the plant brought stormy conditions but under his management these were weathered and the company carried steadily forward on a prosperous path. The growth of the town of Yonkers was naturally reflected in that of the company, the largest day's output increasing from 24,000 cu. ft. to over 1,000,000 cu. ft. during the years he acted as Superintendent. The value of his services were recognized by The United Gas Improvement Company and he was not disturbed in his position when this company came into possession of the old company.

Several devices in somewhat common use in gas works are due to his ingenuity, chief among these being the arrangement for the reversal of the direction of travel of the steam through the fuel in the generator of a carburetted water gas set which is now used on all the larger sets. He also devised a method for automatically controlling outlying holders, which he used at Yonkers.

Assiduous in his attention to duty his vacations were rare. Quiet and unassuming he was open in all his doings and enjoyed the respect and trust of his employees to a high degree so that they stuck by him at all times.

Mr. Slade was elected an active member of the American Gas Light Association October 17th, 1883, and was known by reputation at least to many of its members. He is survived by three sons, two of whom are in active service in the gas business.

GEORGE B. NEAL.

Born May 21st, 1823. Died July 7th, 1901.

George B. Neal was born in what was then known as Newton Lower Falls, and is now part of the city of Newton, Mass. His early education was carried on in the schools of Newton and completed by four years at Harvard College, from which he graduated in 1846 in company with Professor Charles Eliot Norton and Senator Hoar. After completing his undergraduate work he took up the study of law in the Harvard Law School and later in the office of Mr. G. W. Warren and was in due time admitted to the bar. But his energies were soon turned aside from legal work. Mr. Warren was one of the men who organized the Charlestown Gas Company in 1851 and became its first President. He had been very favorably impressed by the industry and business ability of the young law student in his office and when the Gas Company was ready to begin business in 1852 he offered Mr. Neal the posisition of Clerk and Treasurer, which the latter accepted and filled for 49 years.

In 1852 the gas business in the United States was comparatively new and each gas manager had to depend largely upon himself for the solution of the problems that arose. Mr. Neal proved equal to the task and the proprietors of the Charlestown Company never had occasion to regret their choice of a Manager. In addition to his duties with this Company he was also for many years a Director in the Lynn Gas Company and its successor the Lynn Gas and Electric Company, being for part of the time practically its managing director.

Nor were his activities entirely confined to the gas business. He was a Director of two banks and an Insurance Company and Treasurer of the Ancient Charlestown Poors' Fund and was prominent in church and charitable work. His connection with St. John's Episcopal Church dated almost from his coming to Charlestown and his long service was recognized by his election as Senior Warden and Treasurer. Being a good musician and organist he had in his younger days also acted as organist and choirmaster.

He was active in the work of organizing the New England Association of Gas Engineers in January of 1871 and was its first Secretary and Treasurer, serving from its organization until 1884. Having learned the value of association with his co-workers in the gas field he was quick to take advantage of the opportunity offered by the formation of the American Gas Light Association which he joined May 13th, 1874. He was also a member of the Guild of Gas Managers. In the affairs of the American Association as in those of the other Associations he was always active. He held the office of 2nd Vice-President for four years, 1876-79 inclusive, and in this capacity was called upon to preside over one of its meetings, that held in October 1877, owing to the unavoidable absence of the President and 1st Vice-President. Although he did not prepare any papers he could always be depended upon to take part in the discussions, giving the results of his experience as an aid to the clearing up of doubtful points of practice, and could always be found in his seat intent upon the business of each session of the meeting. In his death the Association suffers the loss of a really "active" member, and the meetings will seem incomplete to those who were each year accustomed to expect and receive his cheery greeting and enjoy for a brief time the pleasure of his society.

WILLIAM E. BARROWS.

BORN July 14th, 1842. DIED July 30th, 1901.

William E. Barrows was born in Hudson, Ohio, and began his preparatory education there, completing it at Phillips' Academy, Andover, Mass. Upon the breaking out of the Civil War, he enlisted in the Massachusetts Volunteers and was assigned to duty with the 19th Regiment as Hospital Steward, but by successive promotions reached the rank of Captain and was breveted Major for distinguished services. During part of his service, which lasted until the end of the war, he was Chief of Ambulances of the 2nd Army Corps under General Hancock and also on the staff of General Alex. Webb, Chief of Staff of General Meade.

When relieved from military duty in 1865 he entered the Lowell Machine Shop, in Lowell, Mass., as an apprentice machinist and mill engineer, and after six years' work was given his certificate and appointed to take charge of the Mechanical Department of the Ivanhoe Paper Mills. Later he entered the employ of a firm which imported English cotton and woolen machinery for the purpose of obtaining a better knowledge of such machinery.

In 1875 he was made Assistant Treasurer of the Willimantic Linen Company of Hartford, Conn., of which he afterwards became President. This latter position he resigned to go with the Pullman Palace Car Company, at first as assistant to the President and then as Manager of the Works at Pullman. Resigning from the Pullman Company he practiced his profession of mill engineer for a time, was United States Commissioner to the countries on the west coast of South America in the interest of the New Orleans Exposition, then was Manager of the Hinkley Locomotive Works of Boston, and finally became Manager of the works of the Welsbach Light Company at Gloucester, N. J. When Mr. A. O. Granger retired from the Company Mr. Barrows was elected President and General Manager, positions which he held until his death.

The Welsbach Company had not proved a very successful venture in the first few years of its existence and there was ample scope for the exercise of the mechanical ingenuity and executive ability of the new manager. Being possessed of both in a high degree the effect of his efforts were soon apparent and the great success attained by the company as time went on was largely due to these efforts.

He was given the honorary degree of Master of Arts by Yale in recognition of his contributions to practical political economy. He was a charter member of the American Society of Mechanical Engineers, and a member of several Philadelphia and New York Clubs.

Elected an associate member of the American Gas Light Association, October 16th, 1889, he was by reason of his connection with the Welsbach Company widely and favorably known among its members. The fraternity of gas engineers feels itself under obligations to him for much of the far reaching advantages conferred upon the gas business by the successful development of the Welsbach light under American conditions.

WILLIAM WALLACE GOODWIN.

BORN April 13th, 1833. DIED October 6th, 1901.

William Wallace Goodwin was born at Wethersfield, Conn., but the family went to live in New York when he was two years' old and removed to Philadelphia five years later, so that his attendance at school was principally in the latter city. His school days were, however, terminated at an early age, as in 1845, when only twelve years old, he began work as an employee of the firm of Hopkins and Company. His connection with the gas business dated from 1850, in which year his father was appointed Superintendent of one of the Philadelphia gas works and selected Wm. W. Goodwin as his assistant. This position was held until he became of age, when he went to work with Wm. D. Parrish, who was one of the two or three men who had taken up the, at that time (1854), new industry of the building of gas works.

The towns in Georgia and Alabama were particularly active in organizing gas companies and having gas works built, and in the course of his work in the construction line Mr. Goodwin became impressed with the future prospects of that section of the country, and decided to settle there. Just at this time the following advertisement appeared in the American Gas Light Journal: "SUPERINTENDENT of gas-works wanted for a Southern State. A first class man is wanted, who can come well recommended and will be willing to work negroes as assistants, and is without conscientious scruples with regard to slavery. Address M. A. K. J., Rooms American Gas Light Journal, New York." This he answered and as a result went to Selma, Ala., where he rebuilt the works and was made Superintendent, Engineer, Secretary and Treasurer of the Gas Company.

The career thus begun was, however, cut short by the breaking out of the Civil War. Mr. Goodwin by birth was a "Northerner" and his residence in the South had not been of sufficient length to weaken his Union sentiments so when war became imminent he left Selma, went North, entered the United States service as an Assistant Paymaster in the Navy, and continued as such throughout the war.

At its close he spent a short time in the oil business in Philadelphia and then founded in 1867 the Goodwin Gas Stove and Meter Company. It was in connection with this company that he was known to most of the present generation of gas men. Under his management a large business in meters was soon built up and a beginning was made in the sale of gas stoves, though the value of these stoves as a means of increasing business was not as fully recognized by gas companies in those days as it is at present, the full development of the gas stove business being of comparatively recent date.

Mr. Goodwin was a believer in gas engines and in the early "eighties" his company held the agency for the Clerk engine, the only engine which seemed to promise to be a successful competitor of the "Otto Silent," which had almost complete possession of the gas engine field. But this promise was not fulfilled.

He also devoted attention to physical and chemical instruments for gas men, such as Crookes' Radiometer and apparatus for determining the specific gravity of gas and for rapid analysis of illuminating gas.

Elected an active member of the American Gaslight Association April 16th, 1873, he was a regular attendant at the meetings and a frequent contributor to the Proceedings of the Association, treating the subjects of cooking and heating by gas, the calorific power of gas and the analysis of gas. His last appearance before the Association was at the meeting in 1895, when he delivered a lecture on Acetylene accompanied by experiments. Although in attendance at several meetings since that time, failing health prevented his taking part in the proceedings.

Mr. Goodwin became a Mason soon after he was of age and reached the 33d degree in 1870. For many years he was very prominent in Masonic circles, especially those of New Jersey. In connection with this activity he was an enthusiastic Knight Templar and was at one time Grand Commander of New Jersey.

His connection with the meter business brought him into contact with practically all the gas men in the country and probably no one was more generally known to them all. Generous and charitable almost to a fault he never failed to respond to any of the appeals made in the name of friendship, and often showed the goodness of his heart in a substantial manner during the days of his prosperity. When financial trouble and physical infirmities clouded the last years of his life he found that the bread thrown upon the waters had not been swept away, and was comforted in the time of his adversity by the stanchness of some of the friendships formed in earlier days.

UNITED STATES PATENTS RELATING TO GAS.

Issued from October 1st, 1900, to October 1st, 1901.

October 2, 1900.

658,819. Acetylene-Gas Generator. Thomas F. Williams, Chicago, Ill. Assignor to Edward L. Williams, Gillham, Ark. Filed May 11, 1899. Serial No. 716,370.

658,829. Acetylene-Gas Apparatus. John H. Calkins, Columbus, Ohio. Filed June 9, 1900. Serial No. 19,692.

658,835. Acetylene-Gas Generator. Francis M. Draper, Dana, Ind. Filed Sept. 23, 1899. Serial No. 731,465.

658,858. Gas-Engine. Lewis H. Nash, South Norwalk, Conn., assignor to The National Meter Company, New York, N. Y. Filed Jan. 25, 1897. Serial No. 620,674.

658,893. Gas-Burner. William E. Gibbs, Fanwood, N. J., assignor to Alexander C. Humphreys and Arthur G. Glasgow, New York, N. Y. Filed Dec. 15, 1899. Serial No. 740,376.

658,966. Acetylene-Gas Generating Apparatus. David L. Spaulding, Boston, and Ambrose S. Vose, Brookline, Mass. Filed Nov. 3, 1899. Serial No. 735,695.

658,993. Internal-Combustion Engine. Edward A. Mitchell, London, England. Filed Mar. 8, 1899. Serial No. 708,209.

659,027. Gas-Engine. William S. Halsey, Pittsburg, Pa. Filed Feb. 1, 1900. Serial No. 3,565.

659,046. Coking-Oven. Christopher G. Atwater, Boston, Mass. Filed Nov. 7, 1899. Serial No. 736,168.

659,086. Acetylene-Gas Generator. Oliver J. Moussette, New York, N. Y. Filed Feb. 6, 1900. Serial No. 4,219.

October 9.

659,226. Acetylene-Gas Generator. Isaac L. Harris, Jacksonville, Fla. Filed Apr. 7, 1900. Serial No. 11,982.

659,248. Automatic Gas-Controller. William G. Miller, Pittsburg, Pa. Filed Nov. 20, 1899. Serial No. 737,708.

660,786. SPARKING-PLUG FOR EXPLOSIVE-ENGINES. Edward T. Birdsall, New Rochelle, N. Y., assignor to Desberon Motor Car Co., New York, N. Y. Filed May 9, 1900. Serial No. 16,040.

660,889. ACETYLENE-GAS MACHINE. Joseph M. Coghlan, Sayville, N. Y. Filed Apr. 19, 1900. Serial No. 13,492.

660,932. MANTLE FOR INCANDESCENT LAMPS. Wilhelm H. A. Sieverts, Hamburg, Germany. Filed May 20, 1899. Serial No. 717,592.

660,933. GAS-BURNER. Theodore E. Sinnberg, London, England. Filed Apr. 21, 1900. Serial No. 13,722.

660,940. PREPAYMENT GAS-METER. John Zander, Chicago, Ill. Filed Oct. 16, 1899. Serial No. 733,751.

660,954. FUEL VAPORIZER AND MIXER FOR EXPLOSIVE-ENGINES OR OTHER USES. Albert Hayes, Salt Lake City, Utah, assignor of one-half to Matthew H. Walker, William A. Nelden and Edward F. Colborn, same place. Filed June 4, 1900. Serial No. 19,006.

November 6.

661,165. PROTECTING UNDERGROUND METALLIC STRUCTURES FROM EFFECTS OF ELECTROLYSIS. Lucien I. Blake, Lawrence, Kans. Filed Aug. 9, 1900. Serial No. 26,436.

661,181. SPEED-REGULATOR FOR GAS-ENGINES. John W. Lambert, Anderson, Ind., assignor to the Buckeye Manufacturing Company, same place. Filed Dec. 23, 1899. Serial No. 741,405.

661,276. MUFFLER AND PURIFIER FOR GASOLENE-ENGINES. Gustaf L. Reenstierna, Winchester, Mass. Filed October 12, 1899. Serial No. 733,361.

661,284. ACETYLENE-GAS GENERATOR. Henry E. Brunner, Haywards, Cal. Filed April 27, 1899. Serial No. 714,766.

661,291. SPARKING IGNITER FOR EXPLOSIVE-ENGINES. Axel Johnson, Winchester, Mass. Filed Jan. 31, 1900. Serial No. 3,427.

661,300. EXPLOSIVE-GAS ENGINE. Thomas M. Antisell and Frank L. Antisell, Matawan, N. J. Filed Oct. 5, 1899. Serial No. 732,661.

661,320. ACETYLENE-GAS GENERATOR. Lafayette D. Railsback, Indianapolis, Ind. Filed Nov. 27, 1899. Serial No. 738,393.

661,321. ACETYLENE-GAS GENERATOR. Lafayette D. Railsback, Indianapolis, Ind. Filed May 28, 1900. Serial No. 18,292.

661,333. ACETYLENE-GAS GENERATOR. George L. Wilson, Oak Park, Ill. Filed Dec. 2, 1897. Serial No. 660,469.

661,439. EXPLOSION-ENGINE. Alfred Boulier and Eugéne Boulier, Neuilly, France. Filed July 14, 1900. Serial No. 23,554.

661,445. GAS-PRODUCER. Edward J. Duff, Liverpool, England, assignor of one-half to the United Alkali Company, same place. Filed Feb. 16, 1900. Serial No. 5,519.

November 13.

661,489. BUNSEN BURNER. Frank M. Brooks, New York, N. Y. Filed June 12, 1900. Serial No. 20,094.

661,547. ACETYLENE-GAS GENERATOR. Thomas D. McClary, Washington, D. C., assignor to the Acetylene Lighting Company, of Virginia. Filed Feb. 15, 1900. Serial No. 5,266.

661,569. CARBURETER. John C. Winans, Waldron, Mich. Filed March 1, 1900. Serial No. 6,891.

661,646. BUNSEN BURNER. Levi L. Rowe, Boston, Mass. Filed May 28, 1898. Serial No. 682,001.

661,761. ACETYLENE-GAS GENERATOR. William S. Hamm, Chicago, Ill., assignor to the Adams & Westlake Company, of Illinois. Filed Feb. 26, 1900. Serial No. 6,528.

661,865. GAS MOTOR. Narcisse A. Guillaume, Paris, France. Filed Jan. 5, 1900. Serial No. 497.

661,866. TIME LAMPLIGHTER. John Gunning, Bournemouth, England. Filed April 27, 1900. Serial No. 14,588.

661,867. GAS-PRESSURE REGULATOR. Theodor Hahn, Kötzschenbroda, Germany, assignor to Sigismund Mühlenthal and Max Loewenthal, Berlin, Germany. Filed Sept. 26, 1899. Serial No. 731,724.

November 20.

662,035. GAS-BURNER. Clarence S. Steward, Chattanooga, Tenn. Filed Jan. 14, 1898. Serial No. 666,684.

662,040. EXPLOSION-ENGINE. Thomas L. Sturtevant, Quincy, and Thomas J. Sturtevant, Newton, Mass. Filed Feb. 6, 1900. Serial No. 4,206.

662,062. STEAM-SUPERHEATER FOR GAS-PRODUCERS. Edward J. Duff, Liverpool, England, assignor of one-half to the United Alkali Company, Limited, same place. Filed Feb. 16, 1900. Serial No. 5,520.

662,082. AUTOMATIC SHUT-OFF AND ALARM FOR GAS-BURNERS. James G. McAlpine, Jr., Gilroy, Cal. Filed July 27, 1900. Serial No. 25,010.

662,155. MULTIPLE-CYLINDER EXPLOSIVE-ENGINE. Alfred J. Signor, Elkhart, Ind. Filed Nov. 18, 1899. Serial No. 737,500.

662,170. INCANDESCENT-MANTLE. Albert Koch, Schönberg, Germany. Filed June 28, 1900. Serial No. 21,985.

662,181. GAS-ENGINE. George J. Altham and John Beattie, Jr., Fall River, Mass. Filed May 17, 1900. Serial No. 16,998.

662,276. GAS-GENERATING MACHINE. John F. Kistler, Tacoma, Wash., assignor, by direct and mesne assignments, to the Hydrocarbon Gas Company, same place. Filed Feb. 28, 1900. Serial No. 6,849.

662,315. SPARKING IGNITER FOR EXPLOSIVE-ENGINES. Alfred J. Signor, Elkhart, Ind. Filed Feb. 1, 1899. Serial No. 704,142.

662,317. ELECTRIC-IGNITION PLUG FOR INTERNAL-COMBUSTION ENGINES. Frederick R. Simms, London, England. Filed Aug. 30, 1900. Serial No. 28,595.

662,321. INCANDESCENT GAS-BURNER. Aaron P. Storrs, Owego, N. Y. Filed Oct. 20, 1899. Serial No. 734,184.

662,323. INCANDESCENT GAS-BURNER. Clarence W. Taylor, Sioux City, Iowa. Filed April 23, 1900. Serial No. 13,961.

662,324. INCANDESCENT GAS-BURNER. Clarence W. Taylor, Sioux City, Iowa. Filed June 18, 1900. Serial No. 20,762.

662,381. MANTLE AND MANTLE-SUPPORT FOR INCANDESCENT GAS-LIGHTS. Max Herskovitz and Abraham T. Herskovitz, Chicago, Ill. Filed March 1, 1900. Serial No. 6,974.

November 27.

662,504. ACETYLENE-GAS GENERATOR. Philipp Schreck, Versoix, Switzerland. Filed Nov. 6, 1899. Serial No. 735,979.

662,507. TRIP-LOCK FOR USE IN STARTING EXPLOSIVE-ENGINES. Paul Swenson, Hopkins, Minn. Filed Sept. 21, 1899. Serial No. 731,157.

662,546. ACETYLENE-GAS GENERATOR. Charles Puddefoot, Detroit, Mich. Filed Aug. 12, 1899. Serial No. 726,988.

662,550. FLUID-PRESSURE REGULATOR. Henry C. Sisco, Anderson, Ind. Filed Nov. 8, 1897. Serial No. 657,862.

662,608. GAS-FURNACE. William Swindell, Allegheny, Pa. Filed March 30, 1899. Serial No. 711,068.

662,609. GAS-PRODUCER. Johan O. Trotz, Worcester, Mass. Filed June 19, 1899. Serial No. 721,040.

662,631. COUNTERBALANCE FOR EXPLOSION-ENGINES. Herbert B. Steele, Malden, Mass., assignor to the Atlantic Motor Company, Portland, Me. Original application filed Jan. 18, 1897. Serial No. 619,545. Divided and this application filed July 12, 1897. Serial No. 644,177.

662,718. EXPLOSIVE-ENGINE. Oliver F. Good, Dayton, Ohio. Filed Aug. 25, 1900. Serial No. 27,965.

662,734. INCANDESCENT MANTLE. Emanuel Pikhart, Vienna, Austria-Hungary. Filed Sept. 25, 1900. Serial No. 31,054.

662,831. ANTIVIBRATION LAMP FOR WELSBACH OR OTHER INCANDESCENT LIGHTS. Victor H. Slinack and Edward S. Sanderson, Philadelphia, Pa., assignors to the Pennsylvania Globe Gas Light Company, same place. Filed March 22, 1899. Serial No. 710,031.

662,843. ACETYLENE-GAS GENERATOR. Sern P. Watt, Chicago, Ill., assignor to the Hine-Watt Manufacturing Company, same place. Filed Jan. 27, 1900. Serial No. 3,052.

December 4.

662,909. ACETYLENE-GAS BURNER. John W. Bray, Leeds, England. Filed July 10, 1900. Serial No. 23,156.

662,920. Gas-Making Apparatus. Robert M. Dixon, East Orange, N. J. Filed October 5, 1899. Serial No. 732,617.

662,923. Gas-Producer. Edward J. Duff, Liverpool, England. Filed July 17, 1900. Serial No. 23,913.

662,938. Gas-Regulator. Charles Jacobson, Warren, Pa. Filed Feb. 13, 1900. Serial No. 5,065.

663,007. Acetylene-Gas Generator. Christopher M. Bridges, San Francisco, Cal. Filed June 25, 1900. Serial No. 21,564.

663,054. Acetylene-Gas Generator. Arnold Wegmann-Hauser, Zurich, Switzerland. Filed May 10, 1899. Serial No. 716,280.

663,091. Gas-Engine. Albert D. Garretson, Buffalo, N. Y., assignor to the Garretson Engine Company, same place. Filed March 6, 1899. Serial No. 707,830.

663,106. Explosion-Engine. Henry W. Struss, New York, N. Y. Filed Dec. 8, 1899. Serial No. 739,732.

663,158. Gas-Regulator for Steam-Boilers. William H. Downing, Wittens, Ohio. Filed May 31, 1900. Serial No. 18,649.

663,169. Acetylene-Gas Generator. William Hinge, Kenosha, Wis., assignor to the Badger Brass Manufacturing Company, same place. Filed April 18, 1900. Serial No. 13,299.

663,213. Machinery for Discharging Gas-Retorts. Gaston A. Bronder, New York N. Y. Filed May 12, 1900. Serial No. 16,452.

663,240. Acetylene-Gas Generator. Wolcott Remington, Windsor, Conn., assignor, of one-half to Charles H. Cooley, Hartford, Conn. Filed Aug. 9, 1900. Serial No. 26,367.

663,293. Acetylene-Gas Apparatus. William H. McGoldrick, San Antonio, Tex. Filed March 12, 1900. Serial No. 8,351.

663,301. Acetylene-Gas Generator. Augustus F. Shriver, Arbuckle, Cal., assignor of two-thirds to himself, Walter Storey, San Francisco, and James H. Smith, Stonyford, Cal. Filed Dec. 15, 1899. Serial No. 740,435.

663,312. Acetylene-Gas Generator. James Walton, Phœnicia, N. Y. Filed Feb. 27, 1900. Serial No. 6,721.

663,324. Acetylene-Gas Generator. Will F. Anson, Camden, N. Y. Filed Feb. 5, 1900. Serial No. 4,139.

663,338. Prepayment Vending Appliance. Sheldon J. Glass, Milwaukee, Wis. Filed Aug. 7, 1897. Serial No. 647,483.

December 11.

663,475. Gas-Engine. Hinsdale Smith, Springfield, Mass. Filed May 17, 1899. Serial No. 717,125.

663,623. Apparatus for Generating Gas. Donald Cameron, Frederick J. Commin and Arthur J. Martin, Exeter, England. Filed Aug. 13, 1898. Serial No. 688,501.

663,638. Coke-Oven. Heinrich Poetter, Dortmund, Germany. Filed Feb. 28, 1899. Serial No. 707,158.

663,643. Sparking Igniter for Explosion-Engines. Frederick R. Simms, London, England, and Robert Bosch, Stuttgart, Germany. Filed Sept. 12, 1898. Serial No. 690,764.

663,653. Electric Igniter for Gas-Engines. Walter H. Cotton, Chicago, Ill. Filed Nov. 23, 1898. Serial No. 697,285.

663,661. Automatic Gas Cut-Off. John C. McKallip, Athens, Ohio. Filed Aug. 3, 1900. Serial No. 25,805.

663,677. Surface Condenser. Ben M. Kirker, Cincinnati, Ohio. Filed Sept. 22, 1897. Serial No. 652,533.

663,683. Carbureter. Henry W. Royal, Baltimore, Md., assignor of one-half to William B. Brown, same place. Filed April 10, 1900. Serial No. 12,352.

663,725. Exhaust-Silencer for Explosive-Engines. George Buck, London, England, assignor of one-half to Edward S. Torrey, same place. Filed Apr. 21, 1900. Serial No. 13,760.

663,729. Sparking Igniter for Explosive-Engines. Louis S. Clarke and James G. Heaslet, Ardmore, Pa., assignors to the Auto Car Company, same place and Pittsburg, Pa. Filed Aug. 30, 1900. Serial No. 28,503.

663,771. Acetylene-Gas Apparatus. Frederick Metzger, Hondo, Tex. Filed Mar. 28, 1900. Serial No. 10,538.

663,779. Gas or Oil Heater. Joshua J. Nix, Royersford, Pa. Filed Apr. 4, 1900. Serial No. 11,500.

663,798. Igniter for Explosive-Engines. Gustavus A. Tuerk, Chicago, Ill. Original application filed Mar. 23, 1899. Serial No. 710,481. Divided and this application filed Dec. 29, 1899. Serial No. 741,987.

663,803. Incandescent Gas-Burner. Charles A. Bluhm, Michigan City, Ind. Filed Mar. 24, 1900. Serial No. 10,081.

663,820. Process of Producing Solid Igniting Bodies for Automatic Gas-Igniters. Eugen Nowak, Berlin, Germany. Filed May 19, 1900. Serial No. 17,294.

663,831. Gas-Burner. Charles H. Frye, Buffalo, N. Y., assignor to himself and Arthur E. Jewell, same place. Filed Nov. 11, 1899. Serial No. 736,605.

663,837. Gas-Purifier. Appius C. Swain, San Francisco, Cal., assignor of one-half to Jay Milton Bowers, same place. Filed Apr. 20, 1900. Serial No. 13,653.

December 18.

664,025. Gas-Engine. Lewis H. Nash, South Norwalk, Conn. Filed Mar. 1, 1897. Serial No. 625,431.

664,029. ACETYLENE-GAS GENERATOR. Victor T. Weather, Ione, Cal., assignor of two-thirds to David McCall, same place. Filed July 8, 1900. Serial No. 24,049.

664,110. IGNITER FOR EXPLOSIVE-ENGINES. Clarence O. White, Minneapolis, Minn., assignor of one-half to Edward J. Kimball, same place. Original application filed Mar. 17, 1898. Serial No. 674,163. Divided and this application filed July 15, 1899. Serial No. 723,897.

664,163. COMBINED AUTOMATIC GAS-LIGHT EXTINGUISHER AND ELECTRIC SPARKER. Gustav H. Lippmann, Milwaukee, Wis. Filed Mar. 20, 1900. Serial No. 9,437.

664,355. GAS APPARATUS. John P. Johnston, Oak Park, Ill., assignor to himself and Edward E. Morrell, same place. Filed May 14, 1900. Serial No. 16,604.

664,360. IGNITER FOR GAS OR OIL ENGINES. Albert T. Otto, New York, N. Y. Original application filed Dec. 26, 1896. Serial No. 573,294. Divided and this application filed May 19, 1899. Serial No. 717,417.

664,364. ADJUSTABLE GAS BURNER. Peter G. Van Wie, Detroit, Mich., assignor to the Ideal Manufacturing Company, same place. Filed Nov. 27, 1899. Serial No. 738,279.

December 25.

664,383. APPARATUS FOR STORING AND DISTRIBUTING ACETYLENE GAS. Georges M. A. Claude, St. Mandé, and Georges A. Hess, Paris, France, assignors to Bruno Abdank-Abakanowicz, Parc St. Maur, France. Filed Mar. 1, 1897. Serial No. 625,580.

664,632. INTERNAL-COMBUSTION ENGINE. Walter K. Freeman, Saratoga Springs, N. Y. Filed Oct. 3, 1900. Serial No. 31,898.

664,656. ADJUSTABLE GAS-CHECK. Thaddeus S. Leese, Allegheny, Pa. Filed Apr. 28, 1900. Serial No. 14,680.

664,661. INCANDESCENT IGNITING DEVICE FOR EXPLOSION-ENGINES. Giacomo Miari and Francesco Giusti, Padua, Italy. Filed Dec. 9, 1897. Serial No. 661,222.

664,677. PROCESS OF WASHING GAS. Richard E. Pippig and Otto F. F. Trachmann, Kiel, Germany. Filed Aug. 22, 1900. Serial No. 27,701.

664,689. SPEED-REGULATOR FOR EXPLOSIVE-ENGINES. Henry Sutton, Melbourne, Victoria. Original application filed July 10, 1899. Serial No. 723,379. Divided and this application filed Jan. 22, 1900. Serial No. 2,352.

664,731. ACETYLENE-GAS GENERATOR. Dennie M. Dorman, Binghamton, N. Y. Filed Oct. 28, 1899. Serial No. 735,096.

January 1, 1901.

664,841. MIXER FOR EXPLOSIVE-ENGINES. Charles E. Duryea, Peoria, Ill., assignor to the Duryea Manufacturing Company, same place. Filed Feb. 9, 1899. Serial No. 705,019.

664,842. CARBID-CONTAINER FOR ACETYLENE-GAS GENERATORS. Alfred C. Einstein, St. Louis, Mo. Filed Apr. 3, 1900. Serial No. 11,393.

664,940. ACETYLENE-GAS GENERATOR. William F. Gammeter, Freeport, Ohio, assignor of three-fourths to Robert Stewart, J. Frank McMath, and N. Mac Gray, same place. Filed Nov. 4, 1899. Serial No. 735,741.

665,019. ACETYLENE-GAS GENERATOR. Theodor H. J. Leckband, Adair, Iowa, assignor to the Leckband Generator Company, Des Moines, Iowa. Filed June 6, 1898. Renewed Nov. 23, 1900. Serial No. 37,458.

665,037. IGNITING MECHANISM FOR EXPLOSIVE AND INTERNAL-COMBUSTION ENGINES. Louis B. Smyser, Elizabeth, N. J., assignor to Ferdinand E. Canda, New York, N. Y. Filed Sept. 8, 1898. Serial No. 690,530.

665,082. ANTIVIBRATORY SUPPORT FOR GAS-BURNERS. John Franklin, Norwood, Ohio. Filed Jan. 15, 1900. Serial No. 1,477.

665,266. PROCESS OF MANUFACTURING GAS.- Frederick Purdy, Chicago, Ill. Filed Mar. 7, 1898. Serial No. 672,960.

665,311. INCANDESCENT-GAS-LIGHT APPARATUS. George H. Burrows, Somerville, Mass., assignor to the Incandescent Gas Light Company, Boston, Mass. Filed June 23, 1900. Serial No. 21,252.

665,378. MANUFACTURE OF SELF-IGNITING GAS MEDIUMS. David J. Archer, Toronto, Canada, assignor of one-fourth to William James McMurtry, same place. Filed June 15, 1900. Serial No. 20,444.

January 8.

665,442. ACETYLENE-GAS GENERATOR. Theodor Kautny and Rudolph W. Lotz, Chicago, Ill.; said Kautny, assignor to said Lotz and Arthur C. Lotz, same place. Filed July 1, 1899. Serial No. 722,497.

665,460. REVERSING-GEAR FOR EXPLOSIVE-ENGINES. Robert R. von Paller, Nuremberg, Germany. Filed Aug. 30, 1900. Serial No. 28,592.

665,491. ACETYLENE-GAS GENERATOR. George P. Washburn, Chadron, Neb. Filed Jan. 29, 1900. Serial No. 3,193.

665,568. GAS-GENERATING APPARATUS. Clarence M. Kemp, Baltimore, Md. Filed Apr. 17, 1900. Serial No. 13,235.

665,641. WATER-JACKET FOR EXPLOSIVE-ENGINES. Chas. E. Kemp, Baltimore, Md., assignor of one-half to Clarence M. Kemp, same place. Filed Apr. 17, 1900. Serial No. 13,216.

665,665. GAS-ENGINE. Lucius H. Solomon, Chicago, Ill., assignor to the Webster Manufacturing Company, same place. Filed Oct. 8, 1898. Serial No. 693,038.

665,714. SPEED-REGULATOR FOR EXPLOSIVE-ENGINES. Albert L. Zimmerman, Valparaiso, Ind., assignor of one-half to John W. Cameron, same place. Filed July 29, 1899. Serial No. 725,490.

665,730. GAS-PRODUCER. Edward J. Duff, Liverpool, England. Filed June 7, 1900. Serial No. 19,398.

665,745. Acetylene-Gas Generator. Peter L. Linehan, San José, Cal., assignor of one-half to Joseph W. Delaney, same place. Filed Apr. 17, 1899. Serial No. 713,406.

665,853. Wood-Gas Generator. Dent H. Hogue, Tacoma, Wash. Filed Nov. 10, 1899. Serial No. 736,527.

January 15.

665,881. Rear-Compression Explosive-Engine. Charles R. Daellenbach, Park Gate, Pa. Original application filed Feb. 23, 1900. Serial No. 6,277. Divided and this application filed May 8, 1900. Serial No. 15,896.

666,032. Process of Making Gas. Frank L. Slocum, Pittsburg, Pa. Filed Jan. 10, 1900. Serial No. 931.

666,033. Gas-Generator. Frank L. Slocum, Pittsburg, Pa. Filed Jan. 10, 1900. Serial No. 932.

666,042. Acetylene-Gas Generator. John W. Weeks and Henry C. Earle, Providence, R. I., assignors to Ferdinand H. Allen, Scituate, R. I. Filed Sept. 15, 1900. Serial No. 30,111.

666,105. Electric Igniter for Explosion-Motors. Charles E. Lufbery, Chauny, France. Filed Oct. 14, 1899. Serial No. 733,591.

666,147. Acetylene-Gas Generator. Franklin E. Layton, Corning, N. Y. Filed July 10, 1899. Serial No. 723,322.

666,200. Acetylene-Gas Apparatus. Maurice de Lasserve, Thenon, France. Filed Mar. 16, 1899. Serial No. 709,365.

666,204. Acetylene-Gas Generator. William Miller, Thomasville, Ga. Filed June 28, 1900. Serial No. 21,906.

666,208. Acetylene-Gas Generator James W. Reeder, Golden Dale, Wash. Filed June 9, 1900. Serial No. 19,728.

January 22.

666,257. Process of Making Illuminating-Gas. Eduard R. Besemfelder, Charlottenburg, Germany. Filed Sept. 29, 1899. Serial No. 732,080.

666,260. Gas-Engine. Leopold F. Burger, Anderson, Ind., assignor to the Woolley Foundry and Machine Works, same place. Filed July 1, 1899. Serial No. 722,571.

666,353. Acetylene-Gas Generator. Joseph W. Pritchard, Mitchellville, Iowa. Filed Jan. 18, 1899. Serial No. 702,545.

666,364. Reversible Gas and Steam Engine. William T. Strain, McDonald, and Henry B. Nicodemus, Allegheny, Pa. Filed Mar. 21, 1900. Serial No. 9,602.

666,439. Sparking Igniter for Explosive-Engines. Gustaf L. Reenstierna, Winchester, Mass. Filed Mar. 3, 1900. Serial No. 7,145.

666,501. SPEED-REGULATOR FOR EXPLOSIVE-ENGINES. Albert de Dion and Georges Bouton, Puteaux, France. Filed June 8, 1900. Serial No. 19,601.

666,581. ACETYLENE-GAS GENERATOR. Martin Wagner, Paris, France. Filed Apr. 5, 1900. Serial No. 11,707.

666,591. ACETYLENE-GAS GENERATOR. Theodore G. Ames, Albuquerque, N. Mex. Filed Sept. 2, 1899. Serial No. 729,361.

666,598. GAS HOLDER. Thomas A. Bryan, Baltimore, Md. Filed June 5, 1900. Serial No. 19,160.

666,622. MUFFLER FOR ENGINE-EXHAUST. John C. Gebhart, New Orleans, La., assignor to the Gulf Motor Works, same place. Filed June 25, 1900. Serial No. 21,512.

January 29.

666,657. APPARATUS FOR OBTAINING AMMONIA. Heinrich Fischer, Pecek, Austria-Hungary. Filed Aug. 8, 1899. Serial No. 726,545.

666,678. GAS-BURNER. Jacob Huber, and John H. McGinty, Mansfield, Ohio. Filed May 4th, 1900. Serial No. 15,510.

666,724. ACETYLENE-GAS GENERATOR. Frank S. Wood, Boston, Mass. Filed July 20, 1899. Serial No. 724,498.

666,777. SAFETY DEVICE FOR GAS COCKS. William E. Pattman and Francis J. Clendenning, New York, N. Y. Filed May 24, 1900. Serial No. 17,784.

666,792. SELF-IGNITING GAS-BURNER. Richard Beese, Dresden, Germany. Filed Jan. 15, 1900. Serial No, 1,516.

666,795. GAS-PRODUCER. William H. Bradley, Bellevue, Pa., assignor to the Duff Patents Co., Pittsburg, Pa. Filed Oct. 9, 1900. Serial No. 32,474.

666,826. POWER SYSTEM EMPLOYING EXPLOSIVE-ENGINES. Herbert G. Underwood, New York, N.Y., assignor, by direct and mesne assignments, to the International Power Vehicle Company, of West Virginia. Filed Dec. 14, 1899. Serial No. 740,325.

666,827. IGNITION DEVICE FOR EXPLOSIVE-ENGINES. Herbert G. Underwood, New York, N. Y., assignor by direct and mesne assignments, to the International Vehicle Company, of West Virginia. Filed Dec. 14, 1899. Serial No. 740,326.

666,838. EXPLOSIVE-ENGINE. Horace L. Arnold, New York, N. Y., assignor to John A. Hill, same place. Filed April 2, 1898. Serial No. 676,211.

666,875. CONTROLLING DEVICE FOR ENGINES. Clifton Reeves, Trenton, N. J., assignor of one-half to Andrew C. Reeves, same place. Filed May 1, 1900. Serial No. 15,063.

666,894. Appliance for Producing Perfect Combustion of Gas. Frederick M. Bennett and Jonathan O. Fowler, Jr., New York, N. Y., assignor to the Solar (No Mantle) Incandescent Light Company of West Virginia. Filed Nov. 30, 1900. Serial No. 38,189.

667,161. Acetylene-Gas Generator. William J. Baulieu, Bridgeport, Conn., assignor of one-half to John D. Carpenter, same place. Filed June 23, 1900. Serial No. 21,294.

February 5.

667,178. Acetylene-Gas Generator. Charles S. Bartholf, Chicago, Ill. Filed April 30, 1900. Serial No. 15,001.

667,186. Automatic Gas Cut-Off. Victor E. Campbell, Winnemucca, Nev. Filed Aug. 3, 1898. Serial No. 687,614.

667,451. Acetylene-Gas Generator. Donald H. McPherson, Le Roy, N. Y. Filed April 5, 1900. Serial No. 11,726.

667,489. Sight Device for Gas Apparatus. George S. Brainerd, Boston, Mass. Filed Aug. 14, 1900. Serial No. 26,855.

667,542. Acetylene-Gas Generator. James E. Lytle, Cleveland, Ohio, assignor to the National Acetylene Gas Company, same place. Filed April 30, 1898. Renewed Dec. 29, 1900. Serial No. 41,494.

667,590. Gas or Other Hydrocarbon Engine. William E. Simpson, Nottingham, England. Filed March 20, 1897. Serial No. 628,517.

667,608. Acetylene Burner with Two or Several Flame-Rays. Kuno Thurnauer, Nuremberg, Germany. Filed June 19, 1900. Serial No. 20,900.

February 12.

667,702. Gas-Burner. Howard Hinckley, Washington, D. C. Filed Aug. 3, 1900. Serial No. 25,734.

667,724. Acetylene-Gas Generator. Walter G. Murphy, New York, N. Y. Filed June 12, 1900. Serial No. 20,025.

667,756. Gas Cut-Off. Robert Wynell, San Francisco, Cal. Filed Oct. 4, 1900. Serial No. 31,987.

667,766. Acetylene-Gas Generator. John C. Charbeneau and Joseph Schaldenbrand, Mount Clemens, Mich. Filed Feb. 11, 1899. Serial No. 705,255.

667,792. Igniting Device for Hydrocarbon-Engines. James W. Packard, Warren, Ohio. Filed March 10, 1900. Serial No. 8,182.

667,801. Acetylene-Gas Generator. Coleman K. Sober and Frederick E. Porter, Lewisburg, Pa. Filed Aug. 8, 1900. Serial No. 26,281.

667,846. Explosion Engine or Motor. Samuel Miller, London, England. Filed April 30, 1900. Serial No. 14,877.

667,864. APPARATUS FOR MANUFACTURING GAS. Henry A. Bradley, New York, N. Y. Filed Nov. 6, 1899. Serial No. 736,067.

667,908. SPEED-REGULATOR FOR EXPLOSIVE-ENGINES. William A. Hatcher, Warren, Ohio, assignor to James W. Packard, same place. Filed Jan. 16, 1900. Serial No. 1,666.

667,910. MIXER AND VAPORIZER FOR EXPLOSIVE-ENGINES. William A. Hatcher and James W. Packard, Warren, Ohio; said Hatcher assignor to said Packard. Filed June 26, 1900. Serial No. 21,648.

667,919. ACETYLENE-GAS-GENERATING APPARATUS. Donald McDonald, Yarraville, Victoria. Filed Nov. 15, 1900. Serial No. 36,630.

667,925. GAS-PRODUCER. William Swindell, Allegheny, Pa. Filed Sept. 28, 1900. Serial No. 31,447.

668,042. ANTIVIBRATORY SUPPORT FOR GAS BURNERS. John Franklin, Norwood, Ohio. Filed April 6, 1900. Serial No. 11,848.

668,075. PISTON FOR EXPLOSIVE-ENGINES. William O. Worth, Chicago, Ill., assignor of two-thirds to William R. Donaldson, same place, and Henry W. Kellogg, Battle Creek, Mich. Original application filed Sept. 9, 1899. Serial No. 729,910. Divided and this application filed April 9, 1900. Serial No. 12,200.

668,111. EXPLOSION AND COMBUSTION MOTOR. Wilhelm Maybach, Cannstadt, Germany, assignor to the Daimler Manufacturing Company, New York, N. Y. Filed July 23, 1900. Serial No. 24,594.

February 19.

668,225. APPARATUS FOR MANUFACTURING GAS. Frederic W. C. Schniewind, Pittsburg, Pa., assignor to the United Coke and Gas Company, Charleston, W. Va., and Philadelphia, Pa. Filed Aug. 11, 1897. Serial No. 647,840.

668,249. SELF-LIGHTING GAS-BURNER. Frederich Zacher, Hamburg, Germany. Filed Aug. 30, 1899. Serial No. 728,988.

668,250. EXPLOSIVE-ENGINE. Stanislaus M. Zurawski, Chicago, Ill. Filed Dec. 21, 1899. Serial No. 741,091.

668,288. ACETYLENE-GAS GENERATOR. George P. Gaston, Silver Creek, N. Y. Filed Dec. 13, 1899. Serial No. 740,190.

668,367. SELF-IGNITING BODY AND METHOD OF MAKING SAME. Gustav A. W. Barkowsky, Allegheny, Pa., assignor of one-half to Robert E. Wilson, same place. Filed Sept. 6, 1900. Serial No. 29,143.

668,368. GAS-IGNITING DEVICE. Gustav A. W. Barkowsky, Allegheny, Pa., assignor of one-half to Robert E. Wilson, same place. Filed Sept. 6, 1900. Serial No. 29,144.

668,402. COKING-FURNACE. Port B. Elkins, Pittsburg, Pa. Filed Aug. 31, 1900. Serial No. 28,645.

668,406. SAFETY GAS-COCK. William H. Holt, Providence, R. I., assignor of one-half to John Holt, same place. Filed Dec. 15, 1900. Serial No. 39,942.

February 26.

668,617. ROTARY GAS-ENGINE. William H. Aldrich, Springfield, Ohio. Filed Sept. 18, 1899. Serial No. 730,888.

668,628. INCANDESCENT GAS-LIGHTING BURNER. Georges Delin, Brussels, Belgium. Filed July 14, 1900. Serial No. 23,601.

668,676. INCANDESCENT GAS-BURNER. Emanuel Cervenka and Josef Bernt, Prague, Austria-Hungary. Filed Dec. 16, 1899. Serial No. 740,565.

668,706. CYLINDER WITH LIQUID PACKING FOR EXPLOSION OR INTERNAL-COMBUSTION ENGINES. Ludwig Bayer, Munich, Germany. Filed Feb. 23, 1900. Serial No. 6,261.

668,839. INCANDESCENT IGNITER FOR GAS-ENGINES. Charles J. Macomber, St. Mary, Ohio, assignor to the Auglaize Machine Company, same place. Filed May 4, 1900. Serial No. 15,524.

668,954. EXPLOSION-ENGINE. Charles E. Dawson, Chiswick, England. Filed Sept. 21, 1900. Serial No. 30,692.

Reissue.

11,891. ACETYLENE-GAS GENERATOR. Charles W. Beck, New York, N. Y., assignor by direct and mesne assignments, to the Acetylene Generator Manufacturing Company, of West Virginia. Filed Jan. 3, 1901. Serial No. 42,032. Original No. 617,389, dated Jan. 10, 1899.

March 5.

669,101. INCANDESCIBLE BODY. Henri Reeser, Paris, France. Filed July 3, 1899. Serial No. 722,678.

669,140. PRODUCTION OF COMPRESSED GAS. Wenzl Knapp, Hamburg, Germany. Filed Sept. 7, 1899. Serial No. 729,688.

669,189. INCANDESCENT GAS-BURNER. Appius C. Swain, San Francisco, Cal. Filed April 5, 1900. Serial No. 11,727.

669,233. ELECTRIC IGNITER FOR EXPLOSIVE-ENGINES. William F. Davis, Milwaukee, Wis. Filed Jan. 2, 1900. Serial No. 101.

669,272. GAS-ENGINE. Jesse Walrath, Racine, Wis. Original application filed Dec. 29, 1899. Serial No. 738,660. Divided and this application filed May 21, 1900. Serial No. 17,417.

669,273. REGULATOR-VALVE FOR EXPLOSIVE-ENGINES. Jesse Walrath, Racine, Wis. Filed June 13, 1900. Serial No. 20,160.

669,302. GAS-BURNER. John Franklin, Norwood, Ohio. Filed Oct. 22, 1900. Serial No. 33,838.

669,380. ACETYLENE-GAS GENERATOR. Thomas A. Bryan, Baltimore, Md. Filed June 5, 1900. Serial No. 19,159.

669,404. OVERHEAD REGENERATIVE GAS-LAMP. William H. I. Welch, Bow, England, assignor to the Lamp Manufacturing Company, Limited, London, England. Filed Oct. 5, 1900. Serial No. 32,168.

669,416. EXPLOSIVE-ENGINE. Orville B. Johnson, Tyngsboro, Mass. Filed Sept. 24, 1900. Serial No. 30,949.

669,463. ACETYLENE-GAS GENERATOR. John E. Le Sueur and James W. Tilford, Nashville, Tenn. Filed June 23, 1900. Serial No. 21,329.

March 12.

669,543. ELECTRIC GAS-IGNITER. Oscar von Morstein, Berlin, Germany. Filed Dec. 8, 1896. Serial No. 614,931.

669,650. PROCESS OF ENRICHING GAS. Robert L. Middleton, Washington, D. C., assignor, by mesne assignments, to John R. McLean, Cincinnati, Ohio. Filed Dec. 14, 1900. Serial No. 39,856.

669,651. APPARATUS FOR ENRICHING GAS. Robert L. Middleton, Washington, D. C., assignor by mesne assignments, to John R. McLean, Cincinnati, Ohio. Filed, Dec. 14, 1900. Serial No. 39,857.

669,737. GAS-ENGINE. Elihu Thomson, Swampscott, Mass. Filed Feb. 23, 1898. Serial No. 671,240.

669,741. ACETYLENE-GAS APPARATUS. William W. Camp, Smithville, Canada. Filed Aug. 25, 1898. Serial No. 689,513.

669,765. GAS-FURNACE. Edward P. Reichhelm, Bayonne, N. J. Filed July 12, 1899. Serial No. 723,630.

669,938. ACETYLENE-GAS GENERATOR. John F. Ford, Baltimore, Md., assignor of one-half to Warren H. Sadler, same place. Filed May 31, 1900. Serial No. 18,559.

March 19.

670,101. ACETYLENE-GAS GENERATOR. George L. Elkins, Wharton, Tex. Filed July 20, 1900. Serial No. 24,328.

670,138. SPEED-REGULATOR FOR EXPLOSIVE-ENGINES. Emile L. P. Mors, Paris, France, assignor to Societé Anonyme D'Electricité et D'Automobiles Mors, same place. Filed Mar. 6, 1900. Serial No. 7,517.

670,152. GAS-PRODUCER. Samuel Forter, Pittsburg, Pa., assignor to the Forter-Miller Engineering Company, same place. Filed Sept. 20, 1900. Serial No. 30,616.

670,196. ACETYLENE-GAS GENERATOR. Edmond R. Cook, Sacramento, Cal. Filed Apr. 5, 1900. Serial No. 11,670.

670,259. GAS-GENERATOR. James Trullinger, Bakersfield, Cal., assignor, by mesne assignments, to Caton's Foundry & Machine Company, San José, Cal. Filed June 14, 1900. Serial No. 20,318.

670,311. Explosive-Engine. Eugéne Courvoisier, Bienne, Switzerland. Filed June 10, 1899. Serial No. 720,032.

670,332. Self-Igniting Gas-Burner. Angelo Simonini, Brooklyn, N. Y. Filed Mar. 9, 1900. Serial No. 8,025.

670,333. Self-Igniting Gas-Burner. Angelo Simonini, Brooklyn, N. Y. Filed Mar. 9, 1900. Serial No. 8,026.

670,334. Gas-Lighter. Angelo Simonini, Brooklyn, N. Y. Filed May 28, 1900. Serial No. 18,276.

670,354. Acetylene-Purifying Composition. Georg Döllner, Rixdorf, Germany. Filed Oct. 28, 1898. Serial No. 694,840.

March 26.

670,450. Method of Preparing Materials for Purifying Gas. John P. Ihart, New York, N. Y. Filed Nov. 21, 1900. Serial No. 37,232.

670,451. Method of Preparing Materials for Purifying Illuminating-Gas. John P. Ihart, New York, N. Y. Filed Nov. 21, 1900. Serial No. 37,233.

670,542. Acetylene-Gas Generator. John St. Leger McGinn, Winnipeg, Canada, assignor to Charles Cushing Holland, (trustee,) Montreal Canada. Filed Apr. 1, 1898. Renewed Aug. 23, 1900. Serial No. 27,822.

670,550. Duplex Gas-Engine. William O. Worth, Chicago, Ill., assignor of two-thirds to William R. Donaldson, Louisville, Ky., and Henry W. Kellogg, Battle Creek, Mich. Filed June 13, 1899. Serial No. 720,393.

670,607. Process of Treating Calcium Carbid. Olaf Borch and Lauritz P. Hviid, Copenhagen, Denmark. Filed June 23, 1900. Serial No. 21,343.

670,657. Acetylene-Gas Machine. William J. Baulieu, Bridgeport, Conn., assignor of one-half to John D. Carpenter, same place. Filed Sept. 15, 1899. Serial No. 29,436.

670,696. Acetylene-Gas Generator. Jacob H. Willers, New York, N. Y. Filed Sept. 18, 1900. Serial No. 30,394.

670,803. Gas-Engine. Thomas McMahon, Philadelphia, Pa., assignor of three-fourths to William M. Bunn, same place, and Royer Luckenbach, Colwyn, Pa. Filed Apr. 28, 1900. Serial No. 14,659.

670,815. Acetylene-Gas Generator. Wilson G. Ross, Benicia, Cal. Filed June 6, 1900. Serial No. 19,241.

670,871. Valve-Gear for Explosive-Engines. Arthur J. Frith, New York, N. Y., assignor to Diesel Motor Company of America, same place. Filed July 17, 1899. Serial No. 724,053.

670,914. Sparking Igniter for Internal-Combustion Engines. Carl H. Blomstrom, Marquette, Mich., assignor to the Lake Shore Engine Works, same place. Filed Nov. 8, 1898. Serial No. 695,912.

April 2.

670,933. PRODUCTION OF AUTOMATIC GAS-LIGHTING PILULES. Paul Lehmann, Charlottenburg, Germany. Filed Aug. 27, 1900. Serial No. 28,248.

670,946. ELECTRIC IGNITER FOR GAS-ENGINES. Jacob L. Ash, Lansing, Mich. Filed Nov. 4, 1899. Serial No. 735,812.

670,997. INTERNAL-COMBUSTION ENGINE. James A. McLean, Boston, Mass. Filed Oct. 19, 1900. Serial No. 33,627.

671,001. MANTLE FOR INCANDESCENT LIGHTING. Charles G. Richardson, New York, N. Y. Filed Aug. 19, 1899. Serial No. 727,796.

671,087. ACETYLENE-GAS GENERATOR. George W. MacKenzie, Beaver, Pa. Filed Feb. 5, 1900. Serial No. 3,933.

671,115. GAS-BURNER. James M. Naughton, Columbus, Ohio. Filed May 7, 1900. Serial No. 15,780.

671,160. GAS-ENGINE OR MOTOR. Gustave L. V. Chauveau, Paris, France. Filed June 5, 1900. Serial No. 19,126.

671,236. STEAM-GENERATING EXPLOSION-ENGINE. Louis Renault, Paris, France. Filed Feb. 26, 1900. Serial No. 6,585.

671,275. JACKETED EXPLOSIVE-ENGINE CYLINDER. Alexander Fischer and Albert T. Otto, New York, N. Y. Filed Feb. 19, 1900. Serial No. 5,759.

671,359. INCANDESCENT LIGHTING DEVICE FOR GAS-ENGINES. Benjamin H. Thwaite, London, and Holberry Mensforth, Bradford, England, assignors to the Blast Furnace Power Syndicate, Limited, London, England. Filed Nov. 30. 1900. Serial No. 38,226.

671,375. CARBURETER. Edward B. Gallaher, New York, N. Y. Filed July 5, 1900. Serial No. 22,542.

Reissue.

11,900. INTERNAL-COMBUSTION ENGINE. Rudolf Diesel, Munich, Germany, assignor, by mesne assignments, to the Diesel Motor Company of America. Filed July 3, 1900. Serial No. 22,462. Original No. 608,845, dated Aug. 9, 1898.

April 9.

671,610. INCANDESCENT GAS-BURNER. Charles S. Pinkham, Boston, Mass. Filed August 6, 1900. Serial No. 26,076.

671,630. PROCESS OF MAKING GAS. Ludwig Mond, Northwich, England. Filed June 1, 1898. Serial No. 682,232.

671,693. ACETYLENE-GAS-GENERATING APPARATUS. Edward N. Dickerson, New York, N. Y. Filed June 12, 1897. Serial No. 640,473.

671,718. SPARKING IGNITER FOR EXPLOSIVE-ENGINES. William A. Bole, Pittsburg, Pa., assignor to the Westinghouse Machine Company of Pennsylvania. Filed May 23, 1900. Serial No. 17,770.

671,796. ACETYLENE-GAS GENERATOR. Paul N. L. Girardville, Paris, France. Filed July 19, 1900. Serial No. 24,177.

671,892. GAS-PRODUCER. Alexander Laughlin, Sewickley, Pa. Filed Aug. 13, 1900. Serial No. 26,754.

671,931. VALVE-GEAR FOR EXPLOSIVE-ENGINES. Robert Longtine, Bradford, Pa., assignor to the Bradford Gas Engine Company, same place. Filed May 22, 1900. Serial No. 17,591.

671,934. GAS-ENGINE OR SIMILAR MOTOR. Carl C. Riotte and Eugene A. Riotte, New York, N. Y., assignors by mesne assignments, to the U. S. Long Distance Automobile Company, Elizabeth, N. J. Filed Aug. 30, 1899. Serial No. 728,944.

April 16.

671,952. EXPLOSIVE-ENGINE GOVERNOR. Charles R. Daellenbach, Parkgate, Pa. Filed Feb. 23, 1900. Serial No. 6,277.

672,017. ELECTRIC IGNITER FOR GAS-ENGINES. Luther J. Sevison and Louis D. Cond, Constantine, Mich. Filed June 29, 1900. Serial No. 22,059.

672,186. ACETYLENE-GAS GENERATOR. Joseph T. Edwards, Weaverville, Cal. Filed July 24, 1900. Serial No. 24,677.

672,187. ACETYLENE-GAS GENERATOR. Joseph T. Edwards, Weaverville, Cal. Filed July 24, 1900. Serial No. 24,678.

672,196. SPARKING IGNITER FOR EXPLOSIVE-ENGINES. Frederick R. Simms, London, England. Filed Sept. 14, 1898. Serial No. 690,960.

672,227. ACETYLENE-GAS GENERATOR. Alfred C. Einstein, St. Louis, Mo. Filed July 23, 1900. Serial No. 24,466.

672,332. SPARKING IGNITER FOR EXPLOSIVE-ENGINES. William Roche, Jersey City, N. J. Filed Nov. 20, 1900. Serial No. 37,106.

672,411. ELECTRICAL IGNITER FOR EXPLOSIVE-ENGINES. Madison F. Bates, Lansing, Mich. Filed Dec. 1, 1899. Serial No. 738,794.

672,432. ROTARY EXPLOSIVE-ENGINE. John Sterba, Rochester, N. Y. Filed Sept. 28, 1898. Serial No. 692,117.

April 23.

672,502. ACETYLENE-GAS BURNER. Charles T. Willson, Amenia, N. Y. Filed March 7, 1900. Serial No. 7,674.

672,503. ACETYLENE-GAS BURNER. Charles T. Willson, Amenia, N. Y. Filed Feb. 21, 1901. Serial No. 48,277.

672,508. MEANS FOR PREVENTING BACK FIRING IN INTERNAL-COMBUSTION ENGINES. George H. Lloyd, Sutton Coldfield, England. Filed March 3, 1899. Serial No. 707,643.

672,615. GAS OR GASOLENE ENGINE. John Doorenbos, Kalamazoo, Mich. Filed Feb. 20, 1899. Serial No. 706,198.

672,694. APPARATUS FOR THE MANUFACTURE OF ILLUMINATING GAS AND COKE. Eduard R. Besemfelder, Charlottenburg, Germany. Filed Sept. 28, 1900. Serial No. 31,410.

672,722. INCANDESCENT GAS-BURNER. Clarence W. Taylor, Sioux City, Iowa. Filed Feb. 7, 1901. Serial No. 46,428.

672,748. GAS-BURNER. Charles F. Allen, Massillon, Ohio, assignor to the Dauntless Burner & Gas Stove Company, same place. Filed Aug. 29, 1900. Serial No. 28,425.

672,817. GAS-BURNER. Arthur H. Bennett, Richmond, and Stephen Jones, Moonee Ponds, Victoria. Filed Jan. 5, 1901. Serial No. 42,193.

672,825. GAS-LAMP. John Franklin, Norwood, Ohio. Filed Oct. 22, 1900. Serial No. 33,837.

672,861. STREET LAMP. Victor H. Slinack, Philadelphia, Pa., assignor to Pennsylvania Globe Gas Light Company, same place. Filed Aug. 4, 1899. Serial No. 726,132.

672,875. SPARKING IGNITER FOR EXPLOSIVE-ENGINES. Abraham Bath, New York, N. Y., assignor to Safety Three-Wheel Vehicle Company, same place. Filed Feb. 17, 1900. Serial No. 5,623.

April 30.

672,888. INCANDESCENT GAS-LIGHT APPARATUS. George H. Burrows, Somerville and George L. Weaver, Boston, Mass., assignors to the Incandescent Gas Light Company, Boston, Mass. Filed Dec. 13, 1900. Serial No. 39,662.

672,990. AUTOMATIC GAS CUT-OFF. Harry Shoemaker, Philadelphia, Pa., assignor of one-half to Gustave P. Gehring, same place. Filed Feb. 15, 1901. Serial No. 47,486.

673,029. COOLING MEANS FOR GAS-ENGINES. John W. Raymond, Oil City, Pa., assignor to the Standard Automatic Gas Engine Company, same place. Original application filed Feb. 21, 1898, Serial No. 671,193. Divided and this application filed Sept. 11, 1899. Serial No. 730,069.

673,109. GAS-ENGINE. Gaston A. Bronder, Brooklyn, N. Y. Filed Feb. 16, 1898. Serial No. 670,464.

673,138. GOVERNING DEVICE FOR EXPLOSIVE-ENGINES. Charles A. Miller, Springfield, Ohio. Filed Nov. 26, 1898. Serial No. 697,571.

673,160. METHOD OF IGNITING AND REGULATING COMBUSTION FOR INTERNAL-COMBUSTION ENGINES. Rudolph Diesel, Munich, Germany, assignor to Diesel Motor Company of America, New York, N. Y. Filed Apr. 6, 1898. Serial No. 676,621.

673,170. GAS-HOLDER. Frederick J. Mayer, Baltimore, Md. Filed Dec. 7, 1900. Serial No. 38,996.

673,171. APPARATUS FOR EXTRACTING TAR FROM COAL-GAS. Frederick J. Mayer, Baltimore, Md. Filed Dec. 20, 1900. Serial No. 40,482.

673,259. MEANS FOR REGULATING SIZE OF COMPRESSION-CHAMBERS OF GAS-ENGINES. Camille Hautier, Paris, France. Filed Oct. 16, 1899. Serial No. 733,785.

673,303. INCANDESCENT GAS-BURNER. Clarence W. Taylor, Sioux City, Iowa. Filed Jan. 21, 1901. Serial No. 44,164.

May 7.

673,394. INCANDESCENT-MANTLE SUPPORT. Max Herskovitz and Abraham L. Herskovitz, Chicago, Ill. Filed Feb. 23, 1900. Serial No. 24,551.

673,427. GAS-ENGINE. John Eckhard, Brighton, N. Y., assignor to the Eckhard Motor Co., same place. Filed Sep. 11, 1899. Serial No. 730,130.

673,705. BUNSEN BURNER FOR INCANDESCENT GAS-LIGHTS. Louis Denayrouze, Paris, France. Filed July 8, 1897. Serial No. 643,794.

673,713. SPARK-DISCHARGING DEVICE FOR ELECTRIC LIGHTING FOR GAS-BURNERS. Paul Hoffmann, Charlottenburg, Germany. Filed Mar. 24, 1900. Serial No. 10,076.

673,809. GAS-ENGINE. William O. Worth, Chicago, Ill., assignor of two-thirds to William R. Donaldson, Louisville, Ky., and Henry W. Kellogg, Battlecreek, Mich. Filed July 1, 1899. Serial No. 722,564.

673,843. ACETYLENE-GAS GENERATOR. Peter F. McCaffrey and Thomas E. McCaffrey, Salt Lake City, Utah. Filed Apr. 24, 1900. Serial No. 14,183.

May 14.

673,863. ACETYLENE-GAS GENERATOR. Bartholomew R. Doody, Canton, Mass. Filed Dec. 26, 1900. Serial No. 41,055.

673,901. MIXER AND VAPORIZER FOR GAS-ENGINES. John Eckhard, Brighton, N. Y., assignor to the Eckhard Motor Company, same place. Original application filed Sept. 11, 1899, Serial No. 730,130. Divided and this application filed May 26, 1900. Serial No. 18,103.

673,928. REGENERATIVE COKE-OVEN. Frederic W. C. Schniewind, New York, N. Y., assignor to the United Coke & Gas Company, Charleston, W. Va., and Philadelphia, Pa. Filed Oct. 22, 1900. Serial No. 33,926.

674,027. SPARKER FOR GAS-ENGINES. John G. Snyder, Green Island, N. Y. Filed Mar. 9, 1901. Serial No. 50,427.

674,030. ELECTRIC IGNITER FOR EXPLOSIVE-ENGINES. William G. Stolz, Brooklyn, N. Y. Filed Feb. 5, 1901. Serial No. 46,044.

674,034. SPEED-GOVERNOR FOR EXPLOSIVE-ENGINES. August Krastin, Cleveland, Ohio. Filed June 14, 1900. Serial No. 20,283.

674,064. LIGHTING APPARATUS FOR GAS-BURNERS. Philipp Lenze, Düren, Germany. Filed June 20, 1900. Serial No. 20,964.

674,104. GAS-PRODUCER. William Swindell, Allegheny, Pa. Filed Jan. 28, 1901. Serial No. 45,017.

674,173. AUTOMATIC GAS-IGNITER. Adolph Martini, Berlin, Germany. Filed Aug. 30, 1900. Serial No. 28,557.

674,289. AUTOMATIC SAFETY GAS-VALVE. James M. Wescott, Hornellsville, and Charles B. Smith, Prattsburg, N. Y. Filed Oct. 20, 1900. Serial No. 33,779.

May 21.

674,421. EXPLOSION-ENGINE. Oscar Kopp and William Preston, Paris, France. Filed Dec. 22, 1900. Serial No. 40,755.

674,580. SPEED-REGULATOR FOR EXPLOSIVE-ENGINES. Henry J. Hartig, Brooklyn, N. Y. Filed Apr. 30, 1900. Serial No. 14,795.

674,582. SAFETY GAS-LOCK. Charles H. Lewy, Chicago, Ill. Filed Aug. 18, 1900. Serial No. 27,297.

674,587. ACETYLENE-GAS GENERATOR. Adam E. Schatz, Mount Vernon, N. Y. Filed Sept. 3, 1898. Serial No. 690,184.

674,606. GAS-VALVE. Charles E. Forsythe, Akron, Ohio, assignor of two-thirds to Mark Gair and Philip F. Haas, same place. Filed Feb. 25, 1901. Serial No. 48,812.

674,610. ACETYLENE-GENERATOR. John A. Mosher, Chicago, Ill., assignor to the Adams & Westlake Company, of Illinois. Filed Aug. 22, 1900. Serial No. 27,679.

674,611. ACETYLENE-GAS GENERATOR. John A. Mosher, Chicago, Ill., assignor to the Adams & Westlake Company, of Illinois. Filed Aug. 22, 1900. Serial No. 27,680.

674,612. ACETYLENE-GAS GENERATOR. John A. Mosher, Chicago, Ill., assignor to the Adams & Westlake Company, of Illinois. Filed Feb. 2, 1901. Serial No. 45,728.

674,613. ACETYLENE-GAS GENERATOR. John A. Mosher and William Wishart, Chicago, Ill., assignors to the Adams & Westlake Company, of Illinois. Filed Jan 2, 1901. Serial No. 41,922.

674,695. APPARATUS FOR MAKING COAL-GAS. Edward M. Eidherr, Chicago, Ill. Filed July 19, 1900. Serial No. 24,169.

674,698. ACETYLENE-GAS APPARATUS. Oliver H. Hampton, Williamsburg, Ind. Filed June 28, 1900. Serial No. 21,872.

674,709. GAS-ENGINE. Patrick H. O'Donnell, Chicago, Ill., administrator of John Rourk, deceased. Filed Aug. 4, 1900. Serial No. 25,896.

674,772. GAS-PRODUCER. Harry Hyatt, Cleveland, Ohio, assignor to the Wellman Seaver Engineering Company, same place. Filed Oct. 20, 1900. Serial No. 33,726.

May 28.

674,886. GAS-PRODUCER. Johan O. E. Trotz, Worcester, Mass. Filed June 18, 1900. Serial No. 20,625.

674,887. GAS-PRODUCER. Johan O. E. Trotz, Worcester, Mass. Filed Nov. 8, 1900. Serial No. 35,780.

674,888. GAS-PRODUCER. Johan O. E. Trotz, Worcester, Mass. Filed Nov. 8, 1900. Serial No. 35,781.

674,979. MULTIPLE-CYLINDER EXPLOSIVE-ENGINE. James A. McLean, Boston, Mass. Filed Nov. 23, 1899. Serial No. 738,010.

674,980. ACETYLENE-GAS GENERATOR. Thomas F. O'Herron, Princeton, Ind., assignor to the Dougherty-O'Herron Company, same place. Filed Mar. 30, 1900. Serial No. 10,795.

675,193. NEEDLE-VALVE FOR GAS-BURNERS. James W. Byers, Mercer, Pa. Filed Jan. 3, 1901. Serial No. 41,974.

675,322. CLEANER FOR INCANDESCENT GAS-BURNERS. James W. Byers, Mercer, Pa. Filed Sept. 20, 1900. Serial No. 30,624.

675,348. CHARGE-MIXER FOR INTERNAL-COMBUSTION ENGINES. Charles H. Bryant, London, England, assignor to John Forrest Walters, Twickenham, England. Filed Aug. 23, 1898. Serial No. 689,340.

675,356. GAS STRAINING AND COOLING APPARATUS. George W. MacKenzie, Beaver, Pa. Filed July 11, 1900. Serial No. 23,221.

675,359. GAS-PRODUCER. George A. Orrok, Brooklyn, N. Y., assignor to Fuel Economy and Engineering Company, of New Jersey. Filed Apr. 19, 1900. Serial No. 13,432.

Reissue.

11,909. GAS-ENGINE. Oliver F. Good, Dayton, Ohio. Filed Dec. 29, 1900. Serial No. 41,550. Original No. 634,686, dated Oct. 10, 1899.

June 4.

675,376. ACETYLENE-GAS GENERATOR. Augustine Davis, Chicago, Ill., assignor to W. S. Hunter, same place. Filed Feb. 18, 1901. Serial No. 47,756.

675,461. ACETYLENE-GENERATOR. Edmund R. Angell, Derry, N. H. Filed Apr. 20, 1899. Serial No. 713,780.

675,498. MUFFLER FOR ENGINES. Hiram M. Quick, Paterson, N. J., assignor of one-half to Henry B. King, same place. Filed Feb. 26, 1901. Serial No. 48,928.

675,501. VALVE-GEAR FOR EXPLOSIVE-ENGINES. William G. Stolz, Brooklyn, N. Y. Filed Feb. 5, 1901. Serial No. 46,042.

675,510. AUTOMATIC CUT-OFF FOR GAS-SERVICE PIPES. Charles S. Folsom, Pittsburgh, Pa., assignor to Rund Manufacturing Company, Camden, N. J. Filed Nov. 10, 1897. Serial No. 658,076.

675,524. CATALYTIC GAS-LIGHTER. William H. Porter, New York, N.Y. Charles G. Porter, administrator of said William H. Porter, deceased. Filed Sept. 3, 1898. Serial No. 690,179.

675,557. ELECTRIC IGNITER FOR EXPLOSIVE-ENGINES. Walter H. Cotton, Chicago, Ill., assignor of one-half to Albert Kunze, same place. Filed May 21, 1900. Serial No. 17,474.

675,566. CARBURETER. Robert S. Lawrence, Washington, D.C., assignor, by direct and mesne assignments, to the Standard Light and Heat Company, Dover, Del., and Baltimore, Md. Filed Apr. 14, 1900. Serial No. 12,790.

675,581. VALVE-GEAR FOR GAS-ENGINES. George Alderson, Lasalle, Ill., assignor to Charles Brunner, Peru, Ill. Filed Jan. 25, 1901. Serial No. 44,748.

675,646. PROCESS OF PRODUCING CALCIUM CARBID. John Zimmerman and Isedore S. Prenner, Chicago, Ill. Original application filed Mar. 13, 1899, Serial No. 708,929. Divided and this application filed Aug. 21, 1899. Serial No. 727,964.

675,666. OIL DISTRIBUTER FOR CARBURETERS. William E. Mc Kay, Boston, Mass. Filed Aug. 23, 1900. Serial No. 27,793.

675,712. INCANDESCENT GAS-BURNER. Hermann Burkert, Berlin, Germany. Filed Feb. 6, 1900. Serial No. 4,275.

675,735. GAS-METER SUPPORT. Henry T. Holland, New York, N. Y., assignor to William W. Williamson, same place. Filed Feb. 16, 1901. Serial No. 47,616.

675,755. APPARATUS FOR INDICATING THE PRESENCE OF DANGEROUS GASES. Henry G. Prested, London, England. Filed Oct. 15, 1900. Serial No. 33,124.

675,769. ACETYLENE-GAS GENERATOR. Tyrrell H. Duncombe, St. Thomas, Canada. Filed Feb. 16, 1901. Serial No. 47,596.

675,796. TWO-STROKE-CYCLE GAS-MOTOR ENGINE. Hermann Schumm, Bonn, and Max Münzel, Mulheim, Germany, assignors to the Otto Gas Engine Works, Philadelphia, Pa. Filed Dec. 11, 1899. Serial No. 739,944.

675,819. ACETYLENE-GAS GENERATOR. August H. Deike, Guelph, Canada, assignor of two-thirds to Alexander W. Alexander and John Mitchell, same place. Filed May 31, 1900. Serial No. 18,663.

June 11.

675,951. INCANDESCENT LIGHTING DEVICE. Joseph P. Keating, Philadelphia, Pa. Filed Jan. 18, 1901. Serial No. 43,708.

675,987. ACETYLENE-GAS GENERATOR. James W. Tallmadge, Boston, Mass. Filed Dec. 31, 1900. Serial No. 41,741.

676,025. GAS-RETORT-CHARGING APPARATUS. Gaston A. Bronder, New York, N. Y. Filed Jan. 2, 1900. Serial No. 131.

676,065. AUTOMATIC DRIP FOR GAS-LINES. John W. Hough, Marion, Ind. Filed Apr. 4, 1901. Serial No. 54,343.

676,099. ELECTRIC IGNITER FOR EXPLOSIVE-ENGINES. John V. Rice, Jr., Edgewater Park, N. J. assignor to the John V. Rice, Junior, Company, same place. Filed Aug. 12, 1897. Renewed Nov. 3, 1900. Serial No. 35,390.

676,153. BURNER FOR GLOWING LIGHTS. Oscar Reitz, Nuremberg, Germany. Filed Jan. 18, 1901. Serial No. 43,770.

676,173. REGULATOR FOR GAS-BURNERS. Richard Beese, Dresden, Germany. Filed Jan. 25, 1901. Serial No. 44,742.

676,174. SELF-IGNITING ATTACHMENT FOR GAS-BURNERS. Richard Beese, Dresden, Germany. Filed Jan. 25, 1901. Serial No. 44,743.

676,199. COMBINED GAS AND STEAM GENERATOR. Samuel D. Mott, Passaic, N. J. Filed Oct. 9, 1900. Serial No. 32,535.

676,206. COIN-FREED PREPAYMENT MECHANISM FOR GAS METERS. Albert Stansfield, Oldham, England, assignor to Meters, Limited, Manchester, England. Filed June 6, 1900. Serial No. 19,341.

676,231. PREPAYMENT GAS-METER. John Hawkyard and Joseph Braddock, Oldham, England, assignors to Meters, Limited, Deansgate, Manchester, England. Filed Mar. 25, 1899. Serial No. 710,453.

676,245. APPARATUS FOR MAKING WATER-GAS. Hugo Strache, Vienna, Austria-Hungary, assignor to the Société Internationale du Gaz D'Eau Brevets Strache Société Anonyme, same place. Filed Feb. 19, 1896. Serial No. 579,954.

676,247. STARTING DEVICE FOR EXPLOSIVE ENGINES. Zebulon S. Taylor, New York, N. Y. Filed July 19, 1900. Serial No. 24,179.

676,329. GAS-PRODUCER. Alexander Laughlin, Sewickley, Pa. Filed Aug. 15, 1900. Serial No. 26,982.

676,361. GAS-LIGHTING TORCH. John G. Glover, London, England. Filed Dec. 19, 1900. Serial No. 40,420.

676,374. BURNER. Asa W. Straight, Evanston, Ill., assignor of one-half to the Turner Brass Works, Chicago, Ill. Filed Mar. 10, 1896. Serial No. 582,580.

676,394. GAS-PRODUCER. William Garrett, Cleveland, Ohio, assignor of one-half to John C. Cromwell, same place. Filed Oct. 14, 1899. Renewed Oct 31, 1900. Serial No. 35,050.

June 18.

676,451. GAS-BURNER. Clarence S. Steward, Chattanooga, Tenn. Filed Feb. 27, 1900. Serial No. 6,702.

676,468. IGNITION-PLUG FOR GAS-ENGINES. Norman McClintock, Pittsburg, Pa., assignor to the Aultman Company, of Ohio. Filed Sept. 30, 1899. Serial No. 732,234.

676,523. GAS-ENGINE. Marshall Wood, Montpelier, Vt. Filed Nov. 3, 1899. Serial No. 735,670.

676,615. ACETYLENE-GAS GENERATOR. William J. Baulieu, Bridgeport, Conn., assignor of one-half to John D. Carpenter, same place. Filed Nov. 27, 1899. Serial No. 738,313.

676,616. ACETYLENE-GAS GENERATOR. William J. Baulieu, Bridgeport, Conn., assignor of one-half to John D. Carpenter, same place. Filed June 27, 1900. Serial No. 21,796.

676,628. ACETYLENE-GAS GENERATOR. Frank H. Merrill, Plainfield, and Francis Hickman, Boundbrook, N. J. Filed Aug. 3, 1900. Serial No. 25,787.

676,642. STARTING MECHANISM FOR EXPLOSIVE-ENGINES. Jesse Walrath, Racine, Wis. Filed Oct. 26, 1900. Serial No. 34,465.

676,691. ACETYLENE-GAS GENERATOR. Rudolph Federroll, New York, N. Y. Filed Feb. 2, 1901. Serial No. 45,681.

676,702. ACETYLENE-GAS GENERATOR. George Seagrave, Walthamstow, England. Filed Dec. 10, 1900. Serial No. 39,391.

676,721. INCANDESCENT GAS-BURNER. Ferdinand Logan, Phoenixville, Pa. Filed Jan. 23, 1900. Serial No. 2,518.

676,791. ACETYLENE-GAS GENERATOR. Alfred C. Einstein, St. Louis, Mo. Filed Sept. 10, 1900. Serial No. 29,534.

675,811. SPEED-REGULATOR FOR GAS-ENGINES. Barnard Abel, Titusville, Pa., assignor to the Titusville Iron Co., same place. Filed July 21, 1900. Serial No. 24,405.

676,858. APPARATUS FOR ASCERTAINING THE DENSITY OF GAS. Max Arndt, Aix-la-Chapelle, Germany. Filed May 1, 1895. Serial No. 547,813.

June 25.

676,907. VALVE-GEAR FOR EXPLOSIVE ENGINES. Harry M. McCall, Pittsburg, Pa. Filed Dec. 3, 1900. Serial No. 38,557.

676,954. INCANDESCENT GAS-BURNER. Joseph B. de Léry, New York, N Y., assignor to De Lèry Light Company of New Jersey. Filed May 19. 1899. Serial No. 717,500.

676,960. INCANDESCENT-LIGHT FIXTURE FOR RAILWAY-CARS. Thomas W. L. McGuire, Kansas City, Mo., assignor of one-half to Luther Hammick, same place. Filed Nov. 14, 1899. Serial No. 736,914.

676,964. ACETYLENE-GAS GENERATOR. Archie H. Rife, Macomb, Ill. Filed Sept. 8, 1900. Serial No. 29,401.

676,990. APPARATUS FOR THE MANUFACTURE OF GAS. Commodore R. Miller, Pittsburg, Pa., assignor to the W. J. McClurg Gas Construction Company, same place. Filed May 8, 1899. Serial No. 716,003.

676,992. GAS-GENERATOR. William J. McClurg, Pittsburg, Pa. Filed Dec. 3, 1900. Serial No. 38,508.

677,001. ROTARY EXPLOSIVE-ENGINE. Alfred T. Stimson, Eureka, Cal. Filed Apr. 26, 1900. Serial No. 14,441.

677,045. GAS-CONDENSER. Harry J. Smith, Philadelphia, Pa. Filed Sept. 29, 1898. Renewed Nov. 12, 1900. Serial No. 36,293.

677,048. INTERNAL-COMBUSTION ENGINE. Henning F. Wallmann, Chicago, Ill. Filed Apr. 20, 1900. Serial No. 13,655.

677,084. INCANDESCENT GAS-LIGHT BURNER. Joseph Hudler, Glauchau, Germany. Filed Sept. 1, 1900. Serial No. 28,816.

677,125. Prepayment Gas-Meter. William E. Gibbs, Fanwood, N. J., assignor to Humphreys and Glasgow, New York, N. Y. Filed May 7. 1900. Serial No. 15,742.

677,171. Gas-Burner Tip. Charles W. Bernson, Elmsford, N. Y. Filed Feb. 28, 1901. Serial No. 49,205.

July 2.

677,334. Acetylene-Gas Generator. George W. Benedict and John J. Graf, Cincinnati, Ohio, assignors to the Union Light & Heat Company, same place. Filed Nov. 5, 1900. Serial No. 35,479.

677,336. Retort Gas-Furnace. Hugo Burgmann, Altona, Germany. Filed Feb. 26, 1900. Serial No. 6,631.

677,452. Acetylene-Gas Generator. Horace A. Holmes, Manton, Mich. Filed May 13, 1899. Serial No. 716,628.

677,491. Igniter for Gas-Engines. Clyde Allen, Hazleton, Iowa. Filed Feb. 14, 1901. Serial No. 47,194.

677,558. Fluid-Meter. Horace Chrisman, Wilkinsburg, Pa., assignor to the Pittsburg Meter Company of Pennsylvania. Filed June 20, 1900. Serial No. 20,952.

677,639. Cover for Gas Purifiers. Thomas S. Clapham, Keighley, England. Filed Feb. 23, 1901. Serial No. 48,513.

677,699. Gas and Air Mixer. Gustav Raap, Berlin, Germany, assignor to the "Selas" Gesellschaft mit Beschränkter Haftung, same place. Filed Nov. 21, 1898. Serial No. 696,994.

July 9.

677,865. Gas-Washer. Olaf N. Guldlin, Fort Wayne, Ind. Filed Sept. 20, 1900. Serial No. 30,565.

677,949. Rotary Explosive-Engine. William B. Cuthbertson, New Brighton, Pa. Filed June 6, 1900. Serial No. 19,310.

677,974. Prepayment Fluid-Meter. William E. Gibbs, Fanwood, N. J., assignor to Alexander C. Humphreys and Arthur G. Glasgow, New York, N. Y., (trading under firm name of Humphreys & Glasgow.) Filed Sept. 13, 1900. Serial No. 29,867.

677,991. Acetylene-Gas Generator. Eugene A. Javal, Neuilly, France. Filed Apr. 18, 1900. Serial No. 13,307.

678,154. Gas-Analysis Apparatus. Max Arndt, Aix-la-Chapelle, Germany. Filed Dec. 6, 1899. Serial No. 739,436.

678,209. Automatic Car-Holding Device. William A. Wilson, Murphysboro, Ill. Filed Dec. 22, 1900. Serial No. 40,819.

678,215. Apparatus for Gas Analysis. Max Arndt, Aix-la-Chapelle, Germany. Filed Jan. 3, 1900. Serial No. 285.

July 16.

678,375. Acetylene-Gas Generator. Arthur M. Carey, Middlesbrough, England. Filed Dec. 26, 1899. Serial No. 741,625.

678,389. Acetylene-Gas Generator. Fred Frederick, Omaha, Nebr. Filed Apr. 20, 1901. Serial No. 56,720.

678,437. Apparatus for the Manufacture of Gas. Henry C. Rew, Chicago Ill. Filed June 6, 1895. Serial No. 551,908.

678,546. Speed Regulator for Explosive-Engines. Edgar N. Corson, Los Angeles, Cal., assignor of one-half to Asa G. Corson, same place. Filed Mar. 5, 1901. Serial No. 49,960.

678,550. Acetylene-Gas Burner. Edward N. Dickerson, New York, N. Y. Filed Jan. 22, 1897. Serial No. 620,214.

678,553. Acetylene Gas-Burner. Edward J. Dolan, Philadelphia, Pa. Filed Nov. 4, 1899. Renewed Dec. 26, 1900. Serial No. 41,094.

678,624. Gas-Burner. John C. McKallip, Athens, Ohio. Filed Nov. 5, 1900. Serial No. 35,516.

678,715. Compound Explosion-Engine. Edward Butler, Gateshead, England. Filed Jan. 23, 1901. Serial No. 44,418.

678,792. Shut-Off Valve Device for Gas Pipes and Nozzles. Paul N. L. Girardville, Paris, France. Filed Apr. 22, 1901. Serial No. 56,877.

678,823. Gas-Engine. Clarence C. Bramwell, Hyde Park, Mass. Filed Feb. 25, 1898. Serial No. 671,556.

July 23.

679,053. Vaporizer for Explosive-Engines. Lawrence M. Johnston, Dayton, Ohio. Filed June 5, 1899. Serial No. 719,511.

679,059. Process of Making Coal-Gas. Robert S. Moss, Chicago, Ill., assignor to L. Z. Leiter, same place. Filed Dec. 17, 1900. Serial No. 40,149.

679,117. Gas-Cooling Apparatus. Herbert E. Eddy, Chas. F. Brown, and James J. Hickey, Rumford Falls, Me. Filed Apr. 27, 1901. Serial No. 57,771.

679,152. Valve Mechanism for Explosive-Engines. Harry A. Knox, Springfield, Mass. Filed Sept. 22, 1900. Serial No. 30,817.

679,197. Electrically-Operated Gas-Burner. Holstein W. Webb, Columbus, Ohio. Filed Apr. 27, 1901. Serial No. 57,650.

679,243. Sparking-Igniter for Explosive-Engines. Schiller A. Rhode and Jacob Dubord, Manitowoc, Wis. Filed Aug. 9, 1900. Serial No. 26,431.

679,263. Mixing and Controlling Device for Gas-Engines. Ransom E. Olds, Lansing, Mich. Filed Apr. 21, 1899. Serial No. 713,948.

July 30.

679,315. Acetylene-Gas Generator. Bohumil Holub and Pankrác Dvorácek, Vinohrady-Prague, Austria-Hungary. Filed Oct. 20, 1900. Serial No. 33,750.

679,367. Gas-Engine. Rolla R. Darling, Cleveland, Ohio, assignor to the Beardsley & Hubbs Manufacturing Company, Mansfield, Ohio. Filed Dec. 30, 1899. Serial No. 742,130.

679,389. Governor for Explosive-Engines. Harry M. McCall, Pittsburg, Pa., assignor to the Pittsburgh Gas Engine Company, same place. Filed Jan. 22, 1901. Serial No. 44,277.

679,543. Valve for Gas or Other Pipes. Edward S. Root and Charles S. Demarest, New York, N. Y. Filed Mar. 20, 1901. Serial No. 52,108.

679,619. Gas-Ventilator for Mains. Milton C. Henley, New York, N. Y. Filed Mar. 16, 1901. Serial No. 51,488.

679,620. Acetylene-Gas Generator. Almon F. Hill, Portland, Me. Filed Sept. 4, 1900. Serial No. 28,914.

679,684. Hall Gas-Heater. John W. Mellott, Pittsburg, Pa. Filed Nov. 16, 1900. Serial No. 36,670.

679,697. Apparatus for Gasifying Hydrocarbons. Charles de Haupt, Brussels, Belgium. Filed June 25, 1900. Serial No. 21,530.

679,711. Acetylene-Gas Generator. Eric Berg, San Francisco, Cal. Filed Oct. 10, 1898. Serial No. 693,170.

August 6.

679,726. Acetylene-Gas Generator. Melvin D. Compton, East Orange, N. J. Filed Jan. 10, 1901. Serial No. 42,706.

679,749. Coke-Oven. Louis J. Hirt, Brookline, Mass. Filed Mar. 12, 1901. Serial No. 50,773.

679,761. Apparatus for Purifying Gases. Alexander L. Lion, Paris, France. Filed Apr. 27, 1899. Serial No. 714,717.

679,774. Acetylene-Gas Generator. Edward M. McNamara and James D. O'Reilly, Chicago, Ill. Filed Sept. 2, 1899. Serial No. 729,366.

679,862. Acetylene-Gas Generator. Timothy B. Rider, Fitch Bay, Canada. Filed Oct. 23, 1900. Serial No. 34,094.

679,883. Speed-Regulator for Explosive-Engines. Franz Burger, Fort Wayne, Ind., assignor of three-fourths to Henry M. Williams, same place. Filed May 3, 1899. Serial No. 715,442.

679,885. Gas-Producer. Arthur R. Calder, Steelton, Pa. Filed Nov. 20, 1900. Serial No. 37,142.

679,899. Gas or Other Cock. Charles F. Kincheloe, Quincy, Ill. Filed Mar. 22, 1901. Serial No. 52,383.

679,964. ACETYLENE-GAS APPARATUS. John J. Hendler, Kansas City, Mo., assignor to Alexander Gray, William K. Reeves and Edward K. Reeves, comprising the firm of the International Light and Heat Company, same place. Filed Oct. 23, 1899. Serial No. 734,441.

680,116. VAPORIZER FOR INTERNAL-COMBUSTION ENGINES. Carl H. Bloomstrom, Marquette, Mich., assignor to Lake Shore Engine Works, same place. Original application filed Nov. 8, 1898, Serial No. 695,912. Divided and this application filed Mar. 23, 1901. Serial No. 52,606.

680,161. ACETYLENE-GAS GENERATOR. Edward S. Martindale, Warren, Pa., assignor to the Kinnear Mfg. Co., Limited, same place. Filed Oct. 17, 1899. Serial No. 733,896.

680,199. GAS-HOLDER. Augustine Davis, Chicago, Ill., assignor, by direct and mesne assignments, to Carbolite Construction Company, same place. Filed Sept. 6, 1899. Serial No. 729,600.

August 13.

680,293. ACETYLENF-GAS GENERATOR. Daniel H. Treichler, Niagara Falls, N. Y. Filed July 14, 1900. Serial No. 23,645.

680,346. PIPING SYSTEM FOR GAS DISTRIBUTION. John A. Mosher and William S. Hamm, Chicago, Ill., assignors to the Adams & Westlake Company, of Illinois. Filed Aug. 11, 1900. Serial No. 26,635.

680,422. SPARKING IGNITER FOR GAS ENGINES. John D. Termaat and Louis J. Monahan, Oshkosh, Wis. Filed Oct. 22, 1900. Serial No. 33,845.

680,473. GAS-BURNER AND HEATER. Hamilton K. Boyd, Kittanning, Pa. Filed Feb. 7, 1901. Serial No. 46,352.

680,568. GAS-LAMP LIGHTING OR EXTINGUISHING APPARATUS. Vittorio Croizat, Turin, Italy. Filed Mar. 1, 1900. Serial No. 6,963.

680,616. MULTIPLE-CYLINDER EXPLOSIVE-ENGINE. William J. Pugh, Davenport, Iowa, assignor of one-half to Thomas R. Levis, Rochester, N. Y. Filed Aug. 1, 1900. Serial No. 25,525.

680,636. DEVICE FOR LIGHTING LAMPS BY ELECTRICITY. Henry M. Brigham and Svend M. Meyer, New York, N. Y. Original application filed Feb. 5, 1898, Serial No. 669,237. Divided and this application filed Oct. 26, 1898. Serial No. 694,603.

August 20.

680,758. SPEED REGULATOR FOR EXPLOSIVE-ENGINES. Jean Brellier, Brussels, and Emile Marius, Uccle, Belgium. Filed Oct. 10, 1899. Serial No. 733,192.

680,770. METHOD OF MANUFACTURING GAS. John E. Fry, Philadelphia, Pa., assignor to George Westinghouse, Pittsburg, Pa. Filed Dec. 9, 1899. Renewed Jan. 22, 1901. Serial No. 44,302.

680,777. Method of Preparing Materials for Purifying Gas. John P. Ihart, New York, N. Y. Filed Mar. 19, 1901. Serial No. 51,931.

680,780. Process of Manufacturing Coke. William J. Knox, Pittsburg, Pa., assignor to George Westinghouse, same place. Filed April 21, 1900. Serial No. 13,708.

680,782. Process of Manufacturing Gas. William J. Knox, Pittsburg, Pa., assignor to George Westinghouse, same place. Filed Oct. 5, 1900. Serial No. 32,115.

680,783. Manufacture of Coke. William J. Knox, Pittsburg, Pa., assignor to George Westinghouse, same place. Filed Oct. 5, 1900. Serial No. 32,116.

680,784. Process of Manufacturing Gas. William J. Knox, Pittsburg, Pa., assignor to George Westinghouse, same place. Filed Nov. 12, 1900. Serial No. 36,255.

680,785. Method of Producing Gas. William J. Knox, Pittsburg, Pa. assignor to George Westinghouse, same place. Filed Nov. 12, 1900. Serial No. 36,266.

680,786. Apparatus for Producing Gas. William J. Knox, Pittsburg, Pa., assignor to George Westinghouse, same place. Filed Nov. 12, 1900. Serial No. 36,267.

680,787. Gas Manufacturing System. William J. Knox, Pittsburg, Pa., assignor to George Westinghouse, same place. Filed Nov. 12, 1900. Serial No. 36,268.

680,788. Apparatus for the Manufacture of Gas. William J. Knox, Pittsburg, Pa., assignor to George Westinghouse, same place. Filed Nov. 12, 1900. Serial No. 36,269.

680,789. Apparatus for the Manufacture of Gas. William J. Knox, Pittsburg, Pa., assignor to George Westinghouse, same place. Filed Nov. 14, 1900. Serial No. 36,443.

680,790. Apparatus for the Manufacture of Coke. William J. Knox, Pittsburg, Pa., assignor to George Westinghouse, same place. Filed Feb. 16, 1900. Renewed Nov. 14, 1900. Serial No. 36,515.

680,791. Apparatus for Manufacturing Coke and Gas. William J. Knox, Edgewood Park, Pa., assignor to George Westinghouse, Pittsburg, Pa. Original application filed April 21, 1900, Serial No. 13,708. Divided and this application filed Mar. 9, 1901. Serial No. 50,416.

680,813. Automatic Gas Igniting Device. Angelo Simonini, Gloucester City, N. J. Filed June 5, 1901. Serial No. 63,306.

680,820. Lubricating Device for Gas-Engines. Gustav A. Thode, Osmond, Nebr. Filed Feb. 3, 1898. Serial No. 669,030.

680,827. Gas-Producer. George Westinghouse, Pittsburg, Pa. Filed Jan. 15, 1901. Serial No. 43,431.

680,828. Gas-Producer. George Westinghouse, Pittsburg, Pa. Filed April 25, 1901. Serial No. 57,366.

680,858. Acetylene-Gas Generator. Milton A. Hamilton, Detroit, Michigan. Filed Sept. 11, 1899. Serial No. 730,137.

680,875. Coin-Controlled Mechanism for Prepayment Meters. William W. Marland and Edward Large, Oldham, England. Filed Mar. 12, 1901. Serial No. 50,786.

680,884. Sparking Igniter for Explosive-Engines. Ralph L. Palmer, Mianus, Conn. Filed May 24, 1901. Serial No. 61,795.

680,907. Multiple-Cylinder Explosive-Engine. Arthur F. Bardwell, Mount Vernon, N. Y. Filed Nov. 3, 1900. Serial No. 35,339.

680,923. Starting Device for Explosive-Engines. Thomas B. Jeffery, Chicago, Ill. Filed Mar. 8, 1900. Serial No. 7,795.

680,969. Acetylene-Gas Generator. Alfred C. Einstein, St. Louis, Mo. Filed June 18, 1900. Serial No. 20,628.

680,985. Multiple-Piston Explosive-Engine. William S. Sharpneck, Chicago, Ill., assignor of two-thirds to John D. Ross and Everett W. Brooks, same place. Filed Dec. 13, 1900. Serial No. 39,751.

681,052. Gas-Burner. John Harris, Cleveland, Ohio, assignor, by mesne assignments, to Atlantic Acetylene Burner Co., Jersey City, N. J. Filed June 22, 1900. Serial No. 21,138.

681,111. Self-Starting Explosive-Engine. Edward N. Dickerson, Storall, N. C. Filed Nov. 5, 1900. Serial No. 35,457.

681,162. Gas or Other Explosive-Engine. Andrew C. Wolfe, Denver, Colo., assignor of two-thirds to Frank Dillingham and Charles K. Wolfe, same place. Filed Dec. 17, 1900. Serial No. 40,181.

681,166. Acetylene-Gas Generator. George W. Collin, Bridgeport, Conn. Filed Sept. 19, 1900. Serial No. 30,500.

681,168. Acetylene-Gas Generator. Benjamin J. Graham, Azel C. Buell, and Herbert L. Salisbury, Springfield, Mass. Filed Mar. 6, 1901. Serial No. 50,052.

August 27.

681,183. Gas-Fitting. Ira F. Bessey and Wesley A. Black, Brooklyn, N. Y. Filed Nov. 28, 1900. Serial No. 37,987.

681,267. Fuel-Feed Device for Explosive-Engines. Adolph Sauer, Arbon, Switzerland. Filed Jan. 24, 1900. Serial No. 2,679.

681,287. Speed-Regulator for Explosive-Engines. William O. Worth, Chicago, Ill., assignor of two-thirds to William R. Donaldson, Louisville, Ky. and Henry W. Kellogg, Battlecreek, Mich. Filed June 19, 1899. Serial No. 721,078.

681,311. Prepayment Gas Meter. Ebenezer F. Griffiths, Philadelphia, Pa. Filed Dec. 29, 1900. Serial No. 41,447.

681,382. Feed-Cup for Explosive-Engines. Emil Westman, Minneapolis, Minn., assignor to the Enterprise Machine Company, same place, (partnership composed of William Kampff and N. G. Sampson.) Filed Nov. 2, 1900. Serial No. 35,208.

681,384. INCANDESCENT IGNITING-TUBE FOR GAS ENGINES. Sven J. Anderson, Waltham, Mass. Filed Jan. 22, 1901. Serial No. 44,321.

681,391. MUFFLER FOR GAS OR OTHER ENGINES. Jess B. Fenner, Buffalo, N. Y., assignor to the J. W. Ruger Manufacturing Company, same place. Filed June 15, 1901. Serial No. 64,625.

681,441. EXHAUST MECHANISM FOR EXPLOSIVE ENGINES. William L. Corson, San Francisco, Cal., assignor to the Union Gas Engine Company, same place. Filed Oct. 8, 1900. Serial No. 32,327.

681,523. STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES. Alpha O. Very, Springfield, Mass. Filed Jan. 25, 1901. Serial No. 44,664.

681,590. BURNER FOR INCANDESCENT GAS-LAMPS. William Tice, Philadelphia, Pa. Filed May 14, 1901. Serial No. 60,225.

September 3.

681,704. GAS-ENGINE. Marcus W. Jamieson, Warren, Pa. Filed May 31, 1900. Serial No. 18,606.

681,705. GAS-ENGINE. Marcus W. Jamieson, Warren, Pa. Filed Feb. 16, 1901. Serial No. 47,574.

681,754. SAFETY DEVICE FOR AUTOMATIC ELECTRIC GAS-LIGHTING APPARATUS. Henry C. Thomson, Boston, Mass., assignor, by mesne assignments, to Electric Gas Lighting Company of Maine. Filed Aug. 6, 1900. Serial No. 25,984.

681,842. LIGHTING DEVICE FOR GAS-BURNERS. Edwin F. Banfield, New York, N. Y. Filed Oct. 11, 1900. Serial No. 32,663.

681,897. SPARKING IGNITER FORGAS-ENGINES. Charles H. Wance, Indianapolis, Ind. Filed Oct. 20, 1900. Serial No. 33,722.

681,907. GAS-BURNER. John H. Cliff, George H. Cliff and Thomas D. Wardlaw, Dundas, Canada. Filed Oct. 7, 1899. Serial No. 732,845.

681,980. GAS-BURNER. Heliodor Rostin and Stanislaus Szubert, Berlin, Germany. Filed Mar. 22, 1901. Serial No. 52,355.

682,038. PROCESS OF MAKING GAS. Elijah B. Cornell, Philadelphia, Pa., assignor of one-half to William C. Alderson, same place. Filed Oct. 24, 1900. Serial No. 34,157.

682,039. GAS GENERATOR. Elijah B. Cornell, Philadelphia, Pa., assignor of one-half to William C. Alderson, same place. Filed Oct. 24, 1900. Serial No. 34,158.

682,040. GAS-RETORT. Elijah B. Cornell, Philadelphia, Pa., assignor of one-half to William C. Alderson, same place. Filed Oct. 17, 1900. Serial No. 33,396.

682,055. GAS-BURNER. Edmond Fouché, Paris, France. Filed Jan. 5, 1900. Serial No. 512.

September 10.

682,211. CARBURETER. Edmund B. Ludwig, Kansas City, Mo. Filed Dec. 10, 1900. Serial No. 39,396.

682,336. ELECTRIC SPARKER FOR GAS-ENGINES. Frank R. McMullin, Chicago, Ill. Filed Mar. 8, 1900. Serial No. 7,868.

682,337. MANUFACTURE OF INCANDESCING MEDIA FOR INCANDESCENT LIGHTING. Rasmus A. Nielsen, Copenhagen, Denmark. Filed July 14, 1900. Serial No. 23,594.

682,345. AUTOMATIC CUT-OFF FOR GAS-SERVICE PIPES. Edwin Ruud, Pittsburg, Pa. Filed Feb. 17, 1898. Serial No. 670,655.

682,385. ROTARY EXPLOSIVE-ENGINE. James D. McFarland, Jr., San Francisco, Cal., assignor of one-half to John Bruckman, same place. Filed Dec. 4, 1900. Serial No. 38,665.

682,407. ACETYLENE-GAS GENERATING APPARATUS. William A. Feurt, and Henry H. Martin, Maryville, Mo., assignors to Feurt-Martin Manufacturing and Supply Company, same place. Filed July 26, 1900. Serial No. 24,940.

682,521. PROCESS OF GENERATING ACETYLENE-GAS. Henry S. Blackmore, Mount Vernon, N. Y. Filed Sept. 17, 1896. Renewed Jan. 19, 1901. Serial No. 43,952.

682,527. INCANDESCENT BURNER. James J. Byrnes, Brooklyn, N. Y. Filed May 21, 1901. Serial No. 61,205.

682,567. INTERNAL-COMBUSTION ENGINE. Fritz Reichenbach, Berlin, Germany. Filed July 5, 1901. Serial No. 67,174.

682,583. MULTIPLE-CYLINDER EXPLOSIVE-ENGINE. Schuyler W. Zent, Marion, Ohio. Filed Aug. 10, 1897. Serial No. 647,752.

September 17.

682,606. EXPLOSIVE-ENGINE FOR MOTOR-VEHICLES. Charles E. Duryea, Elizabeth, N. J. Filed July 20, 1897. Serial No. 645,233.

682,757. VALVE-REVERSING MECHANISM FOR EXPLOSIVE ENGINES. Walter W. Scott, New York, N. Y., assignor to Diesel Motor Company of America, same place. Filed Nov. 20, 1899. Serial No. 737,555.

682,788. GAS-ENGINE. Harry H. Campbell and Edgar M. Hawkins, Steelton, Pa. Filed Dec. 18, 1899. Serial No. 740,738.

682,793. MEANS FOR CHARGING GAS-RETORTS. Edward Drory, Berlin, Germany. Filed March 15, 1901. Serial No. 51,351.

682,856. SPARKING IGNITER FOR EXPLOSIVE-ENGINES. William C. Matthias, Reading, Pa., assignor to Adam H. Leader and Henry H. Roland, same place and Alexander Murdock, Hamburg, Pa. Filed April 13, 1901. Serial No. 55,602.

682,880. VALVE-GEAR FOR EXPLOSIVE-ENGINES. James McNeil, Allegheny, Pa. Filed Feb. 28, 1901. Serial No. 49,274.

682,896. Overhead Regenerative Gas-Lamp. William H. I. Welch, Bow, England, assignor to the Lamp Manufacturing Company, Limited, London, England. Filed April 5, 1901. Serial No. 54,505.

682,920. Apparatus for the Treatment of Producer-Gases. Edward J. Duff, Liverpool, England, assignor to the United Alkali Company, Limited, same place. Filed Mar. 16, 1901. Serial No. 51,547.

682,931. Acetylene-Gas Machine. John W. Gregory, St. Joseph, Mo., assignor to the Sunlight Manufacturing and Supply Company, same place. Filed Oct. 23, 1900. Serial No. 34,015.

682,933. Incandescent Igniter for Explosive-Motors. Rasmus P. Hansen, Erindslev Sogn Rödby, Denmark. Original application filed May 4, 1899. Serial No. 715,671. Divided and this application filed May 23, 1900. Serial No. 17,720.

September 24.

683,034. Pressure-Regulator for Gas-Generators. Heinrich Gerdes, Berlin, Germany, assignor to The Firm of Julius Pintsch, same place. Filed Oct. 12, 1900. Serial No. 32,852.

683,065. Process of Producing Illuminating-Gas. George Ottermann, Vienna, Austria-Hungary. Filed Dec. 14, 1899. Serial No. 740,291.

683,080. Gas-Engine. Benjamin F. Stewart, Chicago, Ill. Filed Sept. 20, 1900. Serial No. 30,537.

683,144. Gas-Heater. Edmond W. T. Richmond, Romford, England. Filed Dec. 17, 1900. Serial No. 40,138.

683,152. Explosive-Gas Engine. Victor St. John, Fairmont, Minn. Filed May 8, 1899. Serial No. 716,073.

683,262. Acetylene-Gas Burner. Alfred C. Einstein, St. Louis, Mo. Filed April 15, 1901. Serial No. 55,893.

683,300. Apparatus for the Manufacture of Gas. Howard Lane, Birmingham, England. Filed May 7, 1901. Serial No. 59,142.

683,331. Gas Cooking Apparatus. Edmond W. T. Richmond, Romford, England. Filed Dec. 14, 1900. Serial No. 39,855.

683,393. Prepayment Gas-Meter. John D. Forster, London, England, assignor to Metropolitan Gas Meters, Limited, Old Kent Road, England. Filed April 15, 1901. Serial No. 55,932.

683,409. Process of Making Gas. Howard Lane, Birmingham, England. Filed July 9, 1901. Serial No. 67,632.

UNITED STATES PATENTS RELATING TO GAS.

Expired from October 1st, 1900 to October 1st, 1901.

October 2, 1883.

286,030. Gas-Engine. Siegfried Marcus, Vienna, Austria-Hungary. Filed June 12, 1882.

October 9.

286,170. Gas-Burner. Joseph G. Beale, Leechburg, Pa. Filed Mar. 29, 1883.

286,301. Regenerative Gas-Heater. Chas. E. Hequembourg, Dunkirk, N. Y. Filed June 23, 1883.

286,326. Gas-Regulator. John F. Maxson, Portville, N. Y. Filed July 27, 1883.

286,454. Process of and Apparatus for Making Gas. Andrew B. Lipsey, West Hoboken, N. J., assignor to William Bell, New York, N. Y. Filed Jan. 15, 1883.

286,481. Electric Gas-Lighter. Theodore H. Parker, Boston, Mass., assignor of one-half to Charles E. and Frank Fuller, same place. Filed June 4, 1883.

286,515. Apparatus for Increasing the Illuminating Power of Gas. Frederick Weston, Brixton, County of Surrey, England, assignor to the Weston Gas Improvement Company, of New York. Filed Jan. 19, 1883.

October 16.

286,589. Method of Manufacturing Gas. Amos P. Chamberlain, London, England. Filed Oct. 13, 1882.

October 23.

287,185. Process of Manufacturing Illuminating-Gas. Theodore G. Springer, New York, N. Y. Filed Sept. 15, 1883.

287,218. Means for Lighting and Extinguishing Gas-Lights. David C. Baughman, Albion, Ind. Filed Mar. 3, 1883.

287,277. Process of and Apparatus for Manufacturing Gas. Arthur O. Granger and Joseph H. Collins, Jr., Philadelphia, Pa., assignors to A. O. Granger & Co., same place. Filed Mar. 10, 1883.

287,332. Coke-Oven. Louis Semet, Brussels, Belgium. Filed July 21, 1882.

October 30.

287,433. Gas and Coke Kiln. Hayden H. Hall, New Hamburg, N. Y. Filed Jan. 24, 1883.

287,578. Gas-Engine. George H. Reynolds, New York, N. Y., assignor of one-half to Cornelius H. Delamater, George H. Robinson and William Delamater, same place. Filed May 15, 1883.

287,666. Gas or Vapor Engine. Gardner B. Gray and William B. Gray, Cardington, Ohio. Filed May 23, 1883.

November 6.

287,855. Electric Igniting Device for Gas-Engines. Lewis C. Parker, Yonkers, N. Y. Filed Aug. 7, 1883.

287,897. Gas-Engine. Cyrus W. Baldwin, Chicago, Ill. Filed Sept. 15, 1883.

287,905. Coke-Oven. François Carves, St. Etienne, France. Filed May 9, 1883.

288,090. Composition for Preparing a Heating and Illuminating Gas. Urial King Mayo, Boston, Mass. Filed Aug. 20, 1883.

November 13.

288,323. Process of and Apparatus for Making Ammonia. Thomas B. Fogarty, Brooklyn, N. Y. Filed Sept. 19, 1882.

288,324. Process of and Apparatus for Manufacturing Ammonia. Thomas B. Fogarty, Brooklyn, N. Y. Filed Oct. 9, 1882.

288,396. Gas-Engine. Cyrus W. Baldwin, Chicago, Ill., assignor to William E. Hale, same place. Filed Apr. 11, 1883.

288,439. Torch and Lamp Opener. Alexander C. Humphreys, Bayonne, N. J., assignor to the Pintsch Lighting Company of New Jersey. Filed Aug. 18, 1883.

288,445. Gas-Burner for Heating and Metallurgical Purposes. Jas. E. Karns, Apollo, Pa. Filed June 4, 1883.

288,478. Gas-Motor Engine. Nicolaus A. Otto, Deutz-on-the-Rhine, Prussia, Germany. Filed May 3, 1883.

288,479. Gas-Engine. Nicolaus A. Otto, Deutz-on-the-Rhine, Prussia, Germany. Filed May 3, 1883.

November 20.

288,632. Gas-Engine. Wilhelm Hammerschmidt, Philadelphia, Pa. Filed Aug. 20, 1883.

288,701. Process of and Apparatus for Making Heating and Illuminating Gas. Thos. M. Fell, Brooklyn, N. Y. Filed Feb. 4, 1882. Renewed Oct. 25, 1883.

288,741. Apparatus for the Manufacture of Gas. Roland H. Smith, Pittsburg, Pa. Filed Jan. 11, 1883.

288,777. Automatic Stop-Plug for Gas-Pipes. William F. Cosgrove, Jersey City, N. J. Filed Feb. 10, 1883.

288,877. Gas-Producer. Chas. W. Siemens, Westminster, County of Middlesex, England. Filed Jan. 30, 1883.

288,952. Combined Gas-Engine and Carbureting Apparatus. Henry L. Müller, Birmingham, England. Filed Dec. 14, 1881.

November 27.

289,019. Gas-Engine. Lewis Hallock Nash, Brooklyn, assignor to the National Meter Company, New York, N. Y. Filed Mar. 19, 1883.

289,274. Automatic Cut-Off for Gas. Robert W. H. Kopp, Washington, D. C. Filed Mar. 24, 1883.

289,278. Apparatus for Generating Heating or Illuminating Gas. James E. Leadley, Camden, N. J., assignor of one-half to John Hanlon, New York, N. Y. Filed May 29, 1883.

289,279. Process of and Apparatus for Manufacturing Gas. James E. Leadley, Camden, N. J., assignor of one-half to John Hanlon, New York, N. Y. Filed May 4, 1883.

289,280. Process of and Apparatus for Manufacturing Gas. James E. Leadley, Camden, N. J., assignor of one-half to John Hanlon, New York, N. Y. Filed June 19, 1883.

289,281. Process of and Apparatus for Manufacturing Gas. James E. Leadley, Camden, N. J., assignor of one-half to John Hanlon, New York, N. Y. Filed July 2, 1883.

289,362. Gas-Engine. Frederick W. Turner, St. Albans, England. Filed Nov. 10, 1882.

December 4.

289,691. Gas-Engine. Lewis Hallock Nash, Brooklyn, assignor to the National Meter Company, New York, N. Y. Filed Apr. 18, 1883.

289,692. Gas-Engine. Lewis Hallock Nash, Brooklyn, assignor to the National Meter Company, New York, N. Y. Filed July 5, 1883.

289,693. Gas-Engine. Lewis Hallock Nash, Brooklyn, assignor to the National Meter Company, New York, N. Y. Filed July 11, 1883.

289,774. Gas-Motor. Ernest Körting and Georg Lieckfeld, Hanover, Prussia, Germany. Filed June 30, 1883.

December 11.

289,842. Apparatus for Producing Gas. Erazm J. Jerzmanowski, New York, N. Y. Filed Apr. 3, 1882.

289,914. Process of Producing Combustible Gas. Erazm J. Jerzmanowski, New York, N. Y. Filed Mar. 27, 1883.

December 18.

290,310. GAS-ENGINE. Cyrus W. Baldwin, Chicago, Ill., assignor to William E. Hale, same place. Filed Apr. 11, 1883.

290,441. ELECTRIC GAS-LIGHTING BURNER. Adam Lüngen, New York, N. Y., assignor of one-half to Robert Edwards, same place. Filed Apr. 6, 1882.

290,451. APPARATUS FOR UTILIZING THE WASTE HEAT OF GAS-ENGINES. J. Vaughan Merrick, Philadelphia, Pa. Filed June 18, 1883.

290,491. MEANS FOR FACILITATING THE PASSAGE OF OIL THROUGH PIPES AND MAKING ILLUMINATING-GAS. Luther C. Snell, Olean, N. Y., assignor of one-tenth to John L. Baxter, same place. Filed May 8, 1883.

290,627. GAS-GENERATOR. Lyman C. Beebe, Villisca, assignor of one-half to R. Truman, Afton, Iowa. Filed Oct. 11, 1883.

290,632. GAS-ENGINE. Harmer Denney, Brooklyn, assignor, by direct and mesne assignments, to himself, and Alexander Webster, New York, N. Y. Filed Apr. 11, 1883.

December 25.

290,727. AUTOMATIC GAS-REGULATOR. Myron J. Anück, San Francisco, Cal., assignor to the Pacific Gas Governor Association, same place. Filed Feb. 24, 1883.

290,925. SYSTEM OF MAINS AND PIPES FOR THE DISTRIBUTION OF GAS OR OTHER FLUIDS. Henry C. Rew, Chicago, Ill. Filed May 4, 1883.

290,928. GAS-PURIFIER. Henry C. Rew, Chicago, Ill. Filed May 9, 1883.

290,929. GAS-COOLING APPARATUS. Henry C. Rew, Chicago, Ill. Filed May 9, 1883.

290,930. PROCESS OF AND APPARATUS FOR MANUFACTURING FIXED GAS. Henry C. Rew, Chicago, Ill. Filed May 9, 1883.

January 1, 1884.

291,065. GAS-MOTOR. Hiram S. Maxim, Paris, France. Filed Jan. 16, 1883.

291,102. GAS-MOTOR. Johannes Spiel, Berlin, Germany. Filed Aug. 13, 1883.

291,190. GAS-PURIFYING BOX. Charles W. Isbell, New York, N. Y. Filed Mar. 17, 1883.

291,369. DEVICE FOR CHECKING THE FLOW OF GAS. Emil E. Marass, St. Louis, Mo. Filed Oct. 12, 1883.

291,417. PROCESS OF AND APPARATUS FOR MAKING COAL-GAS. Anton Stamm, Leadville, Colo. Filed Sept. 5, 1882.

291,421. PROCESS OF AND APPARATUS FOR MANUFACTURING GAS. John L. Stewart, Philadelphia, Pa. Filed May 2, 1883.

291,422. Coke-Oven. Heinrich Stier, Zwickwau, Saxony, Germany. Filed June 14, 1883.

291,463. Electric Gas-Generator. Charles E. Ball, Philadelphia, and Charles S. Bradford, Jr., West Chester, Pa., assignors to said Ball. Filed Feb. 24, 1883. Renewed Nov. 12, 1883.

291,475. Gas-Burners for Heating Purposes. Thomas Fletcher, Warrington, County of Lancaster, England. Filed July 11, 1883.

291,480. Gas-Burner. Andrew B. Lipsey, West Hoboken, N. J., assignor to William Bell, New York, N. Y. Filed June 12, 1883.

January 8.

Reissue.

10,436. Apparatus for Manufacturing Gas. John L. Stewart, Philadelphia, Pa. Filed Nov. 15, 1883. Original No. 282,399, dated July 31, 1883.

January 15.

291,860. Apparatus for the Manufacture and Delivery of Heating and Illuminating Gas. William H. Adams, Chicago, Ill. Filed Dec. 4, 1882.

291,948. Gas-Generator. Dexter M. Small, Providence, R. I. Filed Mar. 19, 1883.

292,081. Apparatus for Making Gas. Alfred Wilson, Handsworth, County of Stafford, England. Filed May 4, 1883.

292,082. Apparatus for Making Gas. Alfred Wilson, Handsworth, County of Stafford, England. Filed May 4, 1883.

January 22.

292,178. Explosive-Gas Engine. Alexander Kirk Rider, Walden, N. Y. Filed June 7, 1883.

292,241. Fluid-Pressure Governor. William Lyon, Sheffield, County of York, England. Filed Sept. 15, 1883.

292,341. Purification of Coal-Gas. James T. McDougall, No. 52 Granville Park, Blackheath, County of Kent, England. Filed Mar. 21, 1883.

292,374. Tip for Electric Gas-Burners. Adolph T. Smith, New York, N. Y. Filed July 26, 1883.

292,394. Gas-Producer. John Zellweger, Chicago, Ill. Filed Dec. 28, 1882.

292,395. Gas-Producer. John Zellweger, Chicago, Ill. Filed July 31, 1883.

292,459. Gas-Regulator. Peter Keller, Philadelphia, Pa. Filed June 11, 1883.

January 29.

292,491. Gas-Scrubber. Charles W. Isbell, New York, N. Y. Filed Nov. 29, 1882.

292,536. Regulator for Gas and Water. Abraham E. Cohn, Philadelphia, Pa., assignor of one-third to Levi Simon and Edwin S. Simon, both of same place. Filed Apr. 13, 1883.

292,622. Apparatus for Producing Gas. Geo. W. Billings, Cleveland, Ohio. Filed May 11, 1882.

292,766. Gas-Burner. J. Gardner Sanderson, Scranton, Pa. Filed Sept. 29, 1881.

February 5.

292,864. Gas-Motor Engine. Jakob Schweizer, Soleure, Switzerland. Filed Mar. 2, 1883.

292,894. Gas-Engine. John Charter, Sterling, Ill. Filed Apr. 19, 1883.

292,984. Gas-Purifier Screen or Grid. John Cabot, Lawrence, Mass. Filed Nov. 9, 1883.

293,023. Coking-Furnace. Arthur Richard Baldwin Hiltawski, Zaborze, Upper Silesia, Germany. Filed Nov. 15, 1883.

293,107. Gas-Retort Furnace. Ira N. Stanley, Brooklyn, N. Y., and William A. Stedman, Newport, R. I. Filed Oct. 2, 1883.

293,179. Gas-Engine. Charles Wilden King, Manchester, and Alfred Cliff, London, assignors to Philip Middleton Justice, Chancery Lane, London, England. Filed Apr. 9, 1883.

293,185. Hot-Air or Gas-Engine. Hiram S. Maxim, Paris, France. Filed Jan. 31, 1883.

February 12.

293,330. Electro-Magnetic Gas-Lighter. Evans H. Jenkins, Richmond, Ind. Filed Aug. 6, 1883.

February 19.

293,698. Gas-Stove. John Aldersley, New York, N. Y., assignor of one half to William N. Milsted, Brooklyn, N. Y. Filed July 31, 1883.

293,762. Gas-Motor. Hiram S. Maxim, Paris, France. Filed Mar. 9, 1883.

293,854. Apparatus for the Manufacture of Illuminating-Gas. William H. Douglass, Philadelphia, Pa., assignor to the North American Petroleum Gas Company, New York, N. Y. Filed May 25, 1883.

293,884. Condenser-Scrubber for Gas. Charles W. Isbell, New York, N. Y. Filed Feb. 9, 1883.

February 26.

294,301. APPARATUS FOR PRODUCING AND BURNING GAS. Levi D. York, Portsmouth, Ohio. Filed Jan. 14, 1884.

March 4.

294,409. BURNER. Ira W. Shaler, Brooklyn, N. Y. Filed July 2, 1883.

294,534. APPARATUS FOR MANUFACTURING GAS. Burhans Van Steenbergh, Goshen, N. Y. Filed Oct. 23, 1883.

294,602. HYDROCARBON-GAS GENERATOR. Joseph Flannery, Philadelphia, Pa. Filed Mar. 20, 1883.

March 11.

294,749. CASE FOR OPERATING STOP-COCKS FOR WATER AND GAS PIPES. Everett L. Abbott, South Bend, Ind. Filed Sept. 4, 1882.

294,796. GAS-PRODUCING FURNACE. Nelson M. Langdon, Chester, N. J. Filed May 28, 1883.

294,862. HYDROCARBON-GAS GENERATOR. Joseph Flannery, Philadelphia, Pa. Filed Mar. 20, 1883.

295,020. EXTENSION-CHANDELIER. John C. Knight, Meriden, Conn., assignor of one-half to the Meriden Malleable Iron Company, same place. Filed Nov. 26, 1883.

295,059. ELECTRIC GAS-LIGHTER. Edwin L. Shute, Ansonia, assignor to John E. Earle, New Haven, Conn. Filed Nov. 3, 1883.

295,118. GAS-APPARATUS. Arthur O. Granger, Philadelphia, Pa. Filed June 25, 1883.

March 18.

295,415. GAS-ENGINE. Johannes A. Menck and Alexander Hambrock, Ottensen, near Altona, Germany, assignors, by mesne assignments, to Wm. E. Hale, Chicago, Ill. Filed Jan. 5, 1884.

295,502. GAS-FURNACE. John T. Morgan, Selma, Ala., and Henry F. Hayden, Washington, D. C. Filed June 4, 1883.

March 25.

295,519. EXTENSION-SLIDE CHANDELIER. John P. Bonner, Brooklyn, N. Y., assignor to the William C. Vosburgh Manufacturing Company, (Limited), same place. Filed July 28, 1883.

295,532. GAS-PRESSURE REGULATOR. Lewis G. Francis, La Grange and John A. Tibbs, Hinsdale, Ill. Filed Dec. 13, 1883.

295,784. GAS-ENGINE. Hiram S. Maxim, Paris, France. Filed June 13, 1883.

295,822. APPARATUS FOR MANUFACTURING ILLUMINATING-GAS. James John Shedlock, Barnet, County of Hertford, England. Filed Oct. 9, 1882.

295,832. PROCESS OF AND APPARATUS FOR MANUFACTURING GAS. John L. Stewart, Philadelphia, Pa. Filed Mar. 23, 1883.

April 1.

296,200. PROCESS OF MANUFACTURING HYDROCARBON GAS. William Fitz Charles Mason McCarty, St. Petersburg, Russia, assignor of one-half to Henry Levis, Philadelphia, Pa. Filed Dec. 21, 1883.

296,201. APPARATUS FOR THE MANUFACTURE OF HYDROCARBON GAS. William Fitz Charles Mason McCarty, St. Petersburg, Russia, assignor of one-half to Henry Levis, Philadelphia, Pa. Filed Dec. 21, 1883.

296,289. PROCESS OF GENERATING GAS. Gomer Jones, Washington, D. C., assignor to the Standard Vapor Fuel Iron and Steel Company of New York. Filed Jan. 11, 1884.

296,290. GAS-GENERATOR. Gomer Jones, Washington, D. C., assignor to the Standard Vapor Fuel Iron and Steel Company of New York. Filed Jan 29, 1883. Renewed Jan. 11, 1884.

April 8.

296,320. GAS-BURNER FOR HEATING AND LIGHTING ROOMS. Benjamin F. Enoch, Philadelphia, Pa. Filed Jan. 13, 1883.

296,340. GAS-ENGINE. Hiram S. Maxim, Brooklyn, N. Y. Filed Oct. 31, 1883.

296,341. ELECTRICAL IGNITING DEVICE FOR GAS-ENGINES. Hiram S. Maxim, Brooklyn, N. Y. Filed Jan. 12, 1884.

296,587. BURNER. Andrew B. Lipsey, West Hoboken, N. J., assignor to William Bell, New York, N. Y. Filed May 21, 1883.

296,664. MERCURY GAS-GOVERNOR. John D. Averell, New York, assignor to William Curry, Brooklyn, N. Y. Filed Feb. 2, 1884.

April 22.

297,113. GAS-GOVERNOR. John S. Connelly, Pittsburg, Pa. Filed Nov. 3, 1883.

297,162. PROCESS OF GAS GENERATING. Henry Pratt and John J. Ryan, Chicago, Ill. Filed Aug. 24, 1883.

297,329. GAS-ENGINE. S. Lloyd Wiegand, Philadelphia, Pa. Filed Sept. 18, 1883.

297,373. PRESSURE-REGULATOR. Francis Joseph Freese, Manchester, N. H. Filed Aug. 21, 1883.

297,444. APPARATUS FOR THE MANUFACTURE OF GAS. Henry M. Pierson, Brooklyn, N. Y. Filed Nov. 5, 1883.

April 29.

297,692. GAS-PRESSURE REGULATOR. Gustavus A. Hyde, Sr., Cleveland, Ohio, and Gustavus A. Hyde, Jr., East Saginaw, Mich. Filed Jan. 2, 1884.

May 6.

298,052. CUT-OFF GAS-BURNER. Alvah C. Austin, San Francisco, Cal. Filed June 14, 1883.

298,057. GAS-GENERATOR. Lyman C. Beebe, Villisca, assignor of one-half to Robert Truman, Afton, Iowa. Filed Oct. 11, 1883.

298,215. GAS-BURNER. Andrew B. Lipsey, West Hoboken, N. J., assignor to William Bell, New York, N. Y. Filed July 11, 1883.

May 13.

298,462. APPARATUS FOR GENERATING AND CARBURETING HYDROGEN GAS. Leroy S. Groves, Afton, Iowa, assignor to Joshua F. Bishop, same place, and J. H. Patt, Creston, Iowa. Filed June 23, 1883.

298,531. APPARATUS FOR LIGHTING GAS BY ELECTRICITY. Le Roy S. White, Waterbury, Conn., assignor to the Electric Appliance Company, same place. Filed Jan. 4, 1884.

May 20.

298,868. GAS-BURNER. Andrew B. Lipsey, West Hoboken, N. J., assignor to William Bell, New York, N. Y. Filed July 2, 1883.

May 27.

299,385. PROCESS OF AND APPARATUS FOR PRODUCING HEATING-GAS. Hermann Haug, Dorthmund, Prussia, Germany. Filed Mar. 1, 1883.

299,418. REVOLVING DRUM FOR GAS-METERS AND LOW PRESSURE WATER-METERS. William Coulson Parkinson, London, England. Filed Dec. 30, 1882.

June 3.

299,589. GAS-PURIFIER AND METHOD OF REVIVIFYING IRON SPONGE. Oliver H. Shiras, New Castle, Pa. Filed July 19, 1883.

299,620. GAS-REGULATOR. David Chambers, New York, N. Y., assignor to William C. Howard, same place. Filed Nov. 12, 1883.

299,660. GAS-BURNER. Andrew B. Lipsey, West Hoboken, N. J., assignor to William Bell, New York, N. Y. Filed Nov. 18, 1882.

299,801. GAS-REGULATOR. Chester S. King, Smethport, Pa. Filed Jan. 19, 1884.

299,919. GAS-GENERATOR. Peter English, London, Ontario, Canada. Filed Oct. 22, 1883.

June 10.

300,294. GAS-ENGINE. Joseph S. Wood, Brooklyn, N. Y. Filed Feb. 28, 1884.

300,330. PROCESS OF AND APPARATUS FOR MANUFACTURING GAS. John L. Stewart, Philadelphia, Pa. Filed Aug. 9, 1883.

300,331. PROCESS OF AND APPARATUS FOR MANUFACTURING GAS. John L. Stewart, Philadelphia, Pa. Filed Oct. 9, 1883.

June 17.

300,453. GAS-ENGINE. Edmund Edwards, 40 Southampton Buildings, County of Middlesex, England. Filed Oct. 11, 1883.

300,466. PROCESS OF AND APPARATUS FOR MANUFACTURING GAS. John Hanlon, New York, N. Y., assignor by direct and mesne assignments, to the United Coal and Oil Gas Company, of New York. Filed Oct. 18, 1883.

300,493. EXTENSION-CHANDELIER. Moska Merichenski, Poplar, County of Middlesex, England. Filed Oct. 13, 1882.

300,583. GAS AND LAMP BRACKET. Henry Philip Drew, New York, N.Y. Filed Jan. 3, 1884.

300,584. GAS AND LAMP BRACKET. Henry Philip Drew, New York, N.Y. Filed Jan. 3, 1884.

300,602. WATER-COOLED VALVE. John Hanlon, New York, N. Y. Filed Mar. 8, 1884.

300,661. GAS-MOTOR ENGINE. Niles Hibbard Thompson and Henry C. Swan, Washington, D. C., said Swan assignor to said Thompson. Filed Jan. 8, 1884.

Reissue.

10,490. MANUFACTURE OF ILLUMINATING-GAS. Alfred P. Southwick, Buffalo, N. Y., assignor by mesne assignments, to the United States Equitable Gas Company. Filed Mar. 22, 1884. Original No. 142,289, dated Aug. 26, 1873; Reissue No. 8,567, dated Feb. 4, 1879.

June 24.

300,752. APPARATUS FOR GENERATING GAS OR VAPOR FROM LIQUID HYDROCARBONS. Augustin I. Ambler, Washington, D. C. Filed June 9, 1882.

300,757. GAS-APPARATUS. James M. Bois, East Aurora, N. Y. Filed July 27, 1883.

300,802. PROCESS OF AND APPARATUS FOR MANUFACTURING ILLUMINATING-GAS. Silas C. Salisbury, New York, assignor to Levi P. Rose, Yonkers, N. Y. Filed Dec. 6, 1883.

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A. G. L. J., LXXIII-17-650

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A. G. L. J. LXXIII-18-686. J. G. L., LXXVI-1957-1211
P. A., XVIII-23-520

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A. G. L. J., LXXIV-1-11

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Unproductiveness of the Trade Unionist, J. G. L., LXXVII-1973-599

The Gas Commission of Massachusetts, J. G. L., LXXVII-1973-602

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A Change in the Gas Supply of South London, G. W., XXXIV-883-995

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FINANCE.

INCLUDING MATTERS OF CAPITAL, PURCHASE, SALES, COLLECTIONS, ETC.

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Analysis of the Hastings and St. Leonards Gas Company's Accounts, G. W., XXXIII-851-695

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J. G. L., LXXVI-1956-1140; A. G. L. J., LXXIII-22-851

Coke-Ovens as Gas-Works, Dr. H., Wiechell, A. M. I. W., LXVIII-7-198;
J. G. L., LXXVI-1956-1148; P. A., XIX-3-55

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(Abstract Trans.)
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A. G. L. J., LXXIV-4-28

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J. G. L., LXXVII-1967-210; G. W., XXXIV-862-123

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J. G. L., LXXVII-1969-339

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J. G. L., LXXVII-1973-616; 1974-679; 1975-749; 1976-820.

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A. G. L. J., LXXIV-12-444

Professor Lewes's Latest Patent, J. G. L., LXXVII-1976-820

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J. G. L., LXXVII-1981-1125; 1982-1223; 1984-1377

Mond Gas for the Midlands, G. W., XXXIV-876-710; 877-745; 878-781

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G. W., XXXIV-876-674; J. G. L., LXXVII-1982-1206

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G. W., XXXIV-876-698; J. G. L., LXXVII-1983-1299

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J. G. L., LXXVII-1982-1235; 1983-1322; 1984-1387; 1985-1449

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The Loomis Gas-Producing Plant, J. G. L., LXXVII-1985-1446

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J. G. L., LXXVII-1987-1564

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J. G. L., LXXVII-1987-1572

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Patent Specification, J. G. L., LXXVII-1987-1573

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G. W., XXXIV-882-938; J. G. L., LXXVII-1988-1654

Comparisons of Different Heating and Lighting Gas, Herr Joh. Körting,
G. W., XXXV-885-13

Production of Lighting Gas from Smoke, J. G. L., LXXVIII-1991-83

By-Product Coke Ovens in the United States, Dr. F. Schniewind,
A. G. L. J., LXXV-5-165; P. A., XIX-16-350

Dr. Bueb on Dellwik Water Gas, G. W., XXXV-890-200

The Economical Production of Diluting Gases, C. B. Tully,
J. G. L., LXXVIII-1997-450; A. G. L. J., LXXV-12-443;
G. W., XXXV-891-241

The Dellwik-Fleischer Water-Gas Plant, Emile Demenge,
P. A., XIX-17-368

Water-Gas Installations on the Strache System,
J. G. L., LXXVIII-1997-441; 1998-504

Dellwik Water-Gas Plant at Erfurt, P. A., XIX-18-392

The Production of Illuminating Gas from Coke-Ovens, F. Schniewind, Ph. D.,
J. G. L., LXXVIII-2001-691; G. W., XXXV-897-481; P. A., XIX-20-422

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PLANT.

INCLUDING MATTERS OF LOCATION, DESIGN, CONSTRUCTION AND REPAIRS.

Rules for Heavy Concrete Work, A. G. L. J., LXXIII-15-571

Coal-Handling Machinery, F. D. Marshall, P. A., XVIII-19-423

Inclined Retorts, C. E. Brackenbury, P. A., XVIII-19-428

Separate Gas Producers for the Heating of Retort Benches, G. Eichelbrenner,
A. G. L. J., LXXIII-16-604

The Design of Steam Power Plants, Henry C. Meyer,
A. G. L. J., LXXIII-17-647; 24-925; LXXIV-4-124; 19-727; 21-808

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A. G. L. J., LXXIII-18-689

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Benches for Distilling Coal with Producers Apart, M. G. Eichelbrenner (Abstract), G. W., XXXIII-846-512

Inclined Retorts, A. H. Barret, J. G. L., LXXVI-1958-1278;
A. G. L. J., LXXIII-19-726; P. A., XVIII-22-493

Mechanical Conveyors of Coke in the Paris Gas Company's Works, M. Louvel,
J. G. L., LXXVI-1954-1013

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G. W., XXXIII-852-728; J. G. L., LXXVI-1958-1266
A. G. L. J., LXXIII-24-922
Tapering Discharge-Pipes for Fans, J. G. L., LXXVI-1958-1265
A Centrifugal Gas-Washer, J. G. L., LXXVI-1958-1265
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Abst. Trans. from Journal für Gasbeleuchtung, by Mr. Frederic Egner,
A. G. L. J., LXXIII-24-924
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A. G. L. J., LXXIII-25-966
Expanded Metal and Coke Breeze Concrete Construction,
J. G. L., LXXVII-1964-18
The New Gas Works at Schlieren, Zurich,
J. G. L., LXXVII-1964-20; 1965-80; 1966-137; 1967-201; 1968-265
The Design of Large Coal-Pockets, J. G. L., LXXVII-1966-145
The Steam Turbine, Francis Hodgkinson, P. A., XIX-2-28; 3-50
Edinburgh and Leith Gas Commission—Visit to the New Gas-Works at Granton, J. G. L., LXXVII-1967-222
Johnston's Liquid Spraying Device, *Patent Specification,*
A. G. L. J., LXXIV-5-166
Methods of Preserving Iron from Corrosion, J. G. L., LXXVII-1968-270
Gas-Producers, E. J. Duff, *Patent Specification,*
J. G. L., LXXVII-1968-277
Hot-Coke Conveyors, M. Graham, *Patent Specification,*
J. G. L., LXXVII-1968-278
Retort Ascension-Pipes, Edward A. Harman, J. G. L., LXXVII-1968-279
West's Latest Retort-Charging Machine, *Patent Specification,*
J. G. L., LXXVII-1969-335; A. G. L. J., LXXIV-8-288
Metal Oil Tanks, *Oil Paint and Drug Reporter,* P. A., XIX-4-75
Some Sketches of Gas Governors, J. J. Humphreys, Jr.,
A. G. L. J., LXXIV-10-368
Short Inclined Retorts, *Engineer,* J. G. L., LXXVII-1972-545
The Durability of Cement Steel Structures, J. G. L., LXXVII-1972-541
The Bronder Machine for Discharging Retorts, J. G. L., LXXVII-1973-618
Causes of the Rusting of Iron Work, J. G. L., LXXVII-1974-677
Inclined Retorts and Other Matters, Frederic Egner,
A. G. L. J., LXXIV-12-442
New Hot-Coke Conveying Plant at the Leeds Gas-Works,
J. G. L., LXXVII-1975-753
The Central Gas-Works of Vienna, Herr Th. Herrmann,
J. G. L., LXXVII-1976-812; 1977-874
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J. G. L., LXXVII-1976-811
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Patent Specification,
J. G. L., LXXVII-1977-883
The Proportional Station Meter, George W. Barnes,
A. G. L. J., LXXIV-15-568

Points of Boiler Design, J. G. L., LXXVII-1978-938

The New Gas-Works at Mulhouse, Herr Kellner,
J. G. L., LXXVII-1979-997

Wrinkle Department, Ohio Gas Light Association, Henry L. Doherty, Editor,
P. A., XIX-9-190

Modern Practice in the Manufacture and Distribution of Gas, H. E. Jones,
G. W., XXXIV-874-589

The Production of Concrete under New York State Specifications, *Engineering Record*, A. G. L. J., LXXIV-20-771

The "Rapid" Charging Apparatus, J. G. L., LXXVII-1984-1379

A Test for Free Lime in Portland Cement, J. G. L., LXXVII-1987-1568

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J. G. L., LXXVII-1987-1568

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Superheated Steam, E. H. Foster, A. G. L. J., LXXV-1-9

Gas and Coal Dust Firing, J. G. L., LXXVIII-1990-22

A Retort House Wrinkle, A. G. L. J., LXXV-3-88

Portland Cement Testing, *The Builder*, A. G. L. J., LXXV-5-167

A Practical Test for Linseed Oil, J. G. L., LXXVIII-1992-142

Strength of Masonry Arches, J. G. L., LXXVIII-1993-206

A New Type of Scrubber, R. W. B. Creeke, A. G. L. J., LXXV-9-329
G. W., XXXV-888-129; J. G. L., LXXVIII-1995-336

Automatic Coke-Weigher, M. Dulac, G. W., XXXV-889-172

Gobbe's Quencher-Producer, M. F. Bruyere, G. W., XXXV-889-172

A Retort-Charger, M. A. Cabrier,
G. W., XXXV-889-173; J. G. L., LXXVIII-1996-393

The "Sirocco" Fan, J. G. L., LXXVIII-1994-272

Denaphthalizer for Illuminating Gas, L. Breittmayer,
J. G. L., LXXVIII-1994-281

Modernizing the Carbonizing Plant at Chester, J. G. L., LXXVIII-1994-281

Expanded Metal for the Construction of Purifier-Boxes, P. Bachelay,
J. G. L., LXXVIII-1994-283; A. G. L. J., LXXV-8-291

Automatic Coke-Weighing Apparatus, M. Dulac,
J. G. L., LXXVIII-1995-336

An Improved Serment Respirator, M. Paul Bachelay,
J. G. L., LXXVIII-1996-394

Rust and Anti-Corrosives, P. A., XIX-17-369

Wrinkles, 1 to 8 Inclusive, with Discussions Thereon, Pacific Coast Gas Association, A. G. L. J., LXXV-10-362

Mechanical Conveying of Coal and Coke in Gas-Works, M. Henri Laurain,
J. G. L., LXXVIII-1999-567; A. G. L. J., LXXV-13-484

Coke-Quenching Gas Producer, M. Fernand Bruyere,
G. W., XXXV-894-354; J. G. L., LXXVIII-2002-778

The Mechanical Transport of Materials in Gas-Works, W. R. Chester, M. Inst. C. E., J. G. L., LXXVIII-2000-634
G. W., XXXV-896-443; P. A., XIX-19-402

The Application of the Unit System of Gas Manufacture to its Purification, C. C. Carpenter, M. Inst. C. E., J. G. L., LXXVIII-2000-637
G. W., XXXV-896-440; A. G. L. J., LXXV-15-563

Up-to-Date Granton, J. G. L., LXXVIII-2000-644

The Construction of Inclined Retort Carbonizing Plants, Walter Ralph Herring, M. Inst. C. E., G. W., XXXV-895-397; A. G. L. J., LXXV-14-523
J. G. L., LXXVIII-2002-767; 2003-846; *Editorial*, 2003-829
P. A. XIX-19-411

Presidential Address of Mr. Alex. C. Young at the Waverly Association of Gas Managers, G. W., XXXV-895-409; J. G. L., LXXVIII-2001-716

Ingrey's Automatic Coal Weighing and Recording Machine,
A. G. L. J., LXXV-13-488

Facilitating Respiration in Deleterious Atmospheres,
J. G. L., LXXVIII-2001-715

A Simple Regenerative Setting for Small Gas Works,
G. W., XXXV-896 454

MATERIAL,

INCLUDING PRODUCTION, COMPARISON, HANDLING, STORAGE, ETC.

Fuel Value of California Oil, W. L. Watts, A. G. L. J., LXXIV-1-8

Submarine Oil Wells in California, W. G. Young,
A. G. L. J., LXXIV-3-89

The Oil Year in Ohio and Indiana, A. G. L. J., LXXIV-3-91

Petroleum in California, P. A., XIX-4-77

Oil Fields of California, Prof. Arthur Lakes, P. A., XIX-10-215

The Refining of Petroleum, Edward W. Parker, P. A., XIX-10-219

Composition of Texas Petroleum, Charles F. Mabery, P. A., XIX-12-264

The Burning of Oil in Tanks,
J. G. L., LXXVII-1988-1664; A. G. L. J., LXXV-2-51

Texas Petroleum, P. A., XIX-13-289

Tests of California and Texas Fuel Oils, Howard Stillman,
P. A., XIX-15-326

Oil as a Fuel, Wm. Kennedy, A. G. L. J., LXXV-6-208

Composition, Examination and Application of Benzol,
J. G. L., LXXVIII-1995-341

Coals—Their Composition, Properties and Uses, W. Ivison Macadam,
G. W., XXXV-891-244

Practical Testing of Oils for Gas and Fuel Purposes, L. P. Lowe,
A. G. L. J., LXXV-11-405

MANUFACTURE,

COVERING ALL OPERATION OF WORKS FROM STARTING PLANT TO SENDING OF COMMERCIAL GAS TO STORAGE-HOLDERS.

Practical Notes on Gas Manufacture, S. Carpenter,
J. G. L., LXXVI-1951-835; 1952-895; 1953-953; 1954-1012

Thermic Reactions in the Distillation of Coal, M. Euchène,
J. G. L., LXXVI-1955-1080; 1956-1141; G. W., XXXIII-850-658; 851-697

Boiler Trials and Analyses of Fuel and Chimney Gases, *Abst. Trans.* Dr. H. Bunte,
J. G. L., LXXVI-1955-1090

A Blue Glass Pyrometer, E. H. Earnshaw,
A. G. L. J., LXXIII-21-803; P. A., XVIII-23-518

The Removal of Tar from Water-Gas, W. C. Morris,
A. G. L. J., LXXIII-20-765; P. A., XVIII-23-511

Effect of Benzene and other Hydrocarbons on the Illuminating Power of Incandescent Coal Gas, *Engineer*,
J. G. L., LXXVI-1961-1460

The Working of Regenerative Settings, S. B. Chandley,
J. G. L., LXXVI-1962-1515; G. W., XXXIII-857-939
A. G. L. J., LXXIV-2-42

On Enrichment by Heat, Herr August Klonne, *Abst.*,
G. W., XXXIV-860-55

Johnston's Gas Apparatus, A. G. L. J., LXXIV-4-123

Japanese Gas-Works, *Gas World*, P. A., XIX-3-57

Remarks on Gas Purification, S. J. Fowler, A. G. L. J., LXXIV-9-323

The Proportion of Sulphur Removed in Each Purifying Box, Carroll Miller,
A. G. L. J., LXXIV-9-325

Mr. A. Hooton on the Enrichment of Gas, J. G. L., LXXVII-1973-613

The Manchester Discussion on the Enrichment of Coal Gas,
G. W., XXXIV-869-392, 402

The Enrichment of Gas by Benzol, Thos. Stenhouse,
J. G. L., LXXVII-1976-824

Further Notes on Purification of Gas, S. Carpenter,
J. G. L., LXXVII-1980-1053; 1988-1669; LXXVIII-1990-24; 1991-92
A. G. L. J., LXXIV-19-729; LXXV-4-129

Purification and Methods of Working Purifiers, B. W. Smith,
A. G. L. J., LXXIV-20-764; G. W., XXXIV-876-684
J. G. L., LXXVII-1982-1214

Recuperative Furnaces of To-day: Directions for Operating and Testing, W. E. Steinwedell,
A. G. L. J., LXXIV-21-804; P. A., XIX-11-230; G. W., XXXV-886-49

Memorandum of Six Months of Operation of Inclined Retorts, for the Months of October, November and December, 1900; and January, February and March, 1901, A. H. Barret,
A. G. L. J., LXXIV [illegible] 29

The Use of Air in Purification, G. W., XXXIV-880-847; P. A., XIX-12-267

Inclined Retorts, A. H. Barret, P. A., XIX-13-279

Tests of Liquid Fuel, E. L. Orde, P. A., XIX-14-304

Enrichment of Gas by Benzol, M. A. Lecomte, G. W., XXXV-887-85

Carburation of Gas in the Cold, and Carburation of Air, M. Ad. Bouvier,
G. W., XXXV-887-88

On the Automatic Carburation of Gas by Benzol, M. Lacaze,
G. W., XXXV-887-89

The Influence of the Physical Condition of Coal Subjected to Distillation, M. Verdier,
G. W., XXXV-887-90; J. G. L., LXXVIII-1995-340;
P. A., XIX-17-368

Gas Enrichment, A. Yuill,
G. W., XXXV-889-164; J. G. L., LXXVIII-1994-277; 1995-333

Experience with Carburetted Water Gas Sets, A. C. Beck,
A. G. L. J., LXXV-11-402

The Influence of Enrichment on the Heating Power of Coal Gas, M. Verdier,
J. G. L., LXXVIII-1998-514

The Utilization of Water Gas in the Destructive Distillation of Coal, Vivian B. Lewes,
G. W., XXXV-894-355; J. G. L., LXXVIII-2000-623
P. A., XIX-18-378; A. G. L. J., LXXV-16-603

STORAGE,

Including Matters Pertaining to Gasholders.

The Repairs of a Broken 36-Inch Outlet Pipe from a Gasholder, W. N. Tolman,
A. G. L. J., LXXIII-20-764; P. A., XVIII-22-496

Collapse of a Gasholder at Barking,
G. W., XXXIII-849-617; J. G. L., LXXVI-1955-1097

Difficulties in the Construction of a Concrete Gasholder Tank, F. G. Cockey,
G. W., XXXIII-852-732; J. G. L., LXXVI-1958-1270
A. G. L. J., LXXIII-23-886

Contamination of Water in Gasholder Tanks, J. G. L., LXXVII-1966-144

More About Concrete Tanks, C. W. Andrews,
P. A., XIX-7-141; A. G. L. J., LXXIV-14-523

Steel Gasholder Construction, W. A. Baehr, J. G. L., LXXVII-1985-1444

A Description of a Gasholder and Tank Erected at the Hull Station of the British Gas Light Company, with Some Practical Suggestions on Construction, Joseph Wentworth, J. G. L., LXXVII-1986-1505

Bonnet's System for Guiding Gasholders, J. G. L., LXXVII-1986-1514

The Large Gasholder for Newcastle,
J. G. L., LXXVIII-1990-25; 1991-87; 1992-143

Gasholders, F. J. Mayer, *Patent Specification*, J. G. L., LXXVIII-1990-30

Some Difficulties with a Gasholder, J. G. Tooms,
A. G. L. J., LXXV-10-371; J. G. L., LXXVIII-1997-449

The Principles of Construction of a Proposed Modern Gasholder for Amsterdam, J. Van Rossum Du Chattel, G. W., XXXV-895-402
J. G. L., LXXVIII-2001-706

DISTRIBUTION,

Including Everything Pertaining to the Handling of the Gas from the Holder to the Consumer's Outlet.

The Reduction of the Cost of Distribution by the Use of High Pressures, F. H. Shelton, A. G. L. J., LXXIII-14-526

Economy in High-Pressure Distribution, Frederick H. Shelton.
P. A., XVIII-19-414

Influence of Gas on Asphalt Pavements, *New York Times*,
P. A., XVIII-19-434

Wet and Dry Meters, P. Bigeard, J. G. L., LXXVI-1951-836

Electric Currents and Gas and Water Mains, A. A. Knudson, *Abst.*, *Engineering Record*, J. G. L., LXXVI-1951-843

Dry Meters, Their Advantages and Disadvantages, W. Asselbergs,
J. G. L., LXXVI-1952-899

A Method of Preventing Naphthalene Obstructions, Dr. Bueb,
P. A., XVIII-20-445

Condensation in Relation to Naphthalene Deposits, *Engineer*,
J. G. L., LXXVI-1956-1151

Prepayment Meters in Holland, P. Bolsius, P. A., XVIII-22-497

Wet vs. Dry Meters, G. F. L. Foulger, G. W., XXXIII-851-697

The Standardization of Gas Meter Unions, J. Ferguson Bell,
G. W., XXXIII-851-689; 852-738; J. G. L., LXXVI-1957-1205

A Twelve-Inch Submerged Pipe Line, *Engineering Record*,
A. G. L. J., LXXIII-23-889

Electrolysis of Main Pipes—Need of Protective Regulations by the Board of Trade, J. G. L., LXXVI-1959-1326

Raising the Delivery Capacity of Gas-Mains in South London by Centrifugal Fans, J. G. L., LXXVI-1959-1337

What is the Maximum Delivering Capacity of Mains?
J. G. L., LXXVI-1960-1388

Coin Meters in Germany, G. W., XXXIII-855-863

Transmission of Compressed Gas, *Editorial*, P. A., XVIII-24-534

A Manual of Gas-Fitting, J. G. L., LXXVI-1962-1505

Meter Statement Form, P. A., XIX-2-32

Electrolysis of Gas and Water Pipes—Report to the American Water-Works Association, J. G. L., LXXVII-1965-93

Uniform Gas Pressure, *Editorial*, P. A., XIX-3-43

Decision on Damage by Electrolysis, *Engineering News*, P. A., XIX-3-54

The Question of Electrolysis of Gas and Water Mains, *Editorial*,
J. G. L., LXXVII-1967-193

Electrolysis of Gas and Water Pipes, George Livesey,
J. G. L., LXXVII-1969-340

Practical Gas-Fitting, Henry Vardiman, P. A., XIX-4-74

Mr. Stelfox on Prepayment Meters, J. G. L., LXXVII-1970-414

Electrolysis in the District of Columbia, Grahame H. Powell,
A. G. L. J., LXXIV-8-287

High-Pressure Gas Distribution, J. G. L., LXXVII-1971-455

"Is the Use of Prepayment Meters Increasing and Does it Pay?" Question Box New England Ass'n. Gas Engineers, A. G. L. J., LXXIV-9-329

Electrolysis of Gas and Water Pipes, George Livesey,
J. G. L., LXXVII-1972-543

Electrolytic Corrosion of Underground Pipes Discussed, *Transactions Amer. Inst. of Electrical Engineers*, P. A., XIX-6-127

Street Maps, Paul Challis, P. A., XIX-6-114; A. G. L. J., LXXIV-12-449

A Gas Pumping Station, E. E. Eysenbach,
A. G. L. J., LXXIV-13-485; 14-522; P. A., XIX-7-139
Naphthalene Remedies, J. G. L., LXXVII-1975-756
Paraffin for Coating Gas-Pipes, J. G. L., LXXVII-1975-758
The Question of Electrolysis, G. W., XXXIV-871-474
Gas and Water Mains and Electrolysis, *Electrician*,
J. G. L., LXXVII-1977-897
The Proportional Station Meter, George W. Barnes, P. A., XIX-9-183
Electrolysis—The Effect of Stray Trolley Currents, H. E. McGowann,
A. G. L. J., LXXIV-17-645; P. A., XIX-10-212
Gas Distribution as Viewed by an Electrical Man, Hubert S. Wynkoop,
A. G. L. J., LXXIV-18-682
Knudson on Electrolysis of Street Mains, J. G. L., LXXVII-1981-1110
The Manchester Preventative for Electrolysis in Gas-Pipes,
J. G. L., LXXVII-1983-1306
A French Opinion of Electrolysis of Pipes, M. Claude,
A. G. L. J., LXXIV-23-889
A New View of Electrolysis, *Editorial*, J. G. L., LXXVII-1986-1494
The Detection of Gas Leakages,
J. G. L., LXXVII-1986-1504; A. G. L. J., LXXIV-25-968
An Electrolysis Survey at Columbus, Ohio, *Engineering Record*,
A. G. L. J., LXXIV-24-931
Concrete Subways for Underground Pipes, A. Taylor Allen,
J. G. L., LXXVII-1987-1570; G. W., XXXV-890-208-211
Prepayment Meter Accounts and Records, E. W. Bell,
A. G. L. J., LXXIV-25-966; P. A., XIX-13-285;
G. W., XXXV-897-480
Professor Caldwell on the Electrolysis of Pipes, J. G. L., LXXVII-1989-1744
Report of the Master in Chancery on the Peoria Electrolysis Litigation,
Engineering Record, A. G. L. J., LXXV-1-5
The Novelty Pipe Coupling, A. G. L. J., LXXV-1-9
The Question of Electrolysis, G. W., XXXIV-884-1032
Sir John Kennaway's Committee and Electrolysis,
J. G. L., LXXVIII-1990-15
House of Commons Committee—London United Tramways Bill, Electrolysis
of Gas and Water Mains, J. G. L., LXXVIII-1990-35
A Peculiar Example Concerning the Deterioration of Wrought Iron Pipe,
William Wark, A. G. L. J., LXXV-5-166
Pumping Natural Gas, A. S. Moon, P. A., XIX-15-322
Removal of Naphthalene from Gasholder Connections,
J. G. L., LXXVIII-1994-283; A. G. L. J., LXXV-11-410
The Electrolysis Question in America—The Peoria Litigation,
J. G. L., LXXVIII-1994-289
Submerged Inverted Syphon of the Massachusetts Pipe Line Gas Co., at
Everett, Mass., W. W. Cummings, P. A., XIX-16-340
Subaqueous Tunnels for Gas Conduits, W. W. Cummings,
P. A., XIX-17-358; 18-382

Difficult Water Pipe Laying at Pittsburg, A. G. L. J., LXXV-11-410

Destruction of Gas Pipes by Means of Electricity, Dr. W. Leybold, J. G. L., LXXVIII-2000-630; G. W., XXXV-896-446; A. G. L. J., LXXV-14-526; P. A., XIX-19-408

Concrete Subways for Underground Pipes, Arthur Allen, P. A., XIX-18-386

LIGHTING.

Consumption of Gas and Appliances Therefor.

A Remarkable Oil, *Trans. from Der Gastechniker Gas World*, P. A., XVIII-19-427

Tests Upon the Influence of Time in Burning upon the Candle Power of Incandescent Mantles, Dr. Emil Liebenthal, P. A., XVIII-19-431

The Development of Artificial Lighting, Herr C. Kjaer, J. G. L., LXXVI-1951-842

In the Interest of Good Public Lighting, *Editorial*, J. G. L., LXXVI-1953-941

Rational and Artistic Fittings For Incandescent Gas Lighting, J. G. L., LXXVI-1953-950

Systems of Illumination Graphically Compared, Ad. Bouvier, J. G. L., LXXVI-1953-954; G. W., XXXIII-848-580

The Use of Hydrocarbons as Illuminants in Competition with Gas, A. Lecomte, J. G. L., LXXVI-1953-955

M. Pierron on Self-Lighting Gas-Burners, J. G. L., LXXVI-1953-959; 1954-1023

The Kitson High-Power Incandescent Oil-Lamp, J. G. L., LXXVI-1953-961

New Matchless Gas Lighter, Chas. D. Sherman, P. A., XVIII-20-447

Public Lighting in Paris, M. Auguste Levy, *Abstract*, G. W., XXXIII-846-511

The Theory of the Incandescent Gas Light, a Lecture Delivered by Dr. E. G. Love, A. G. L. J., LXXIII-19-728; J. G. L., LXXVI-1958-1277; P. A., XVIII-23-510

Notes on the Public Lighting of the Town of Guayaquil, Charles Guichard, J. G. L., LXXVI-1954-1019

Gas Lighting in the Champ-de-Mars and Trocadero, Paris, M. Auguste Levy, J. G. L., LXXVI-1955-1084

Origin of Monazite, Orville A. Derby, P. A., XVIII-21-473

Electric vs. Platinum Lighters, Walter Irving, P. A., XVIII-21-475

Incandescent Gas-Mantle Competition, J. G. L., LXXVI-1956-1135

The Incandescent Gas-Mantle and its Uses, Prof. Vivian B. Lewes, A. G. L. J., LXXIII-21-806; 22-842; 23-882

The Foulger-Glover Lamplighters' Torch, J. G. L., LXXVI-1957-1203

High-Pressure Gas for Incandescent Lighting, A. W. Onslow, G. W., XXXIII-852-735; J. G. L., LXXVI-1958-1273

How to Brighten Street Frontages, J. G. L., LXXVI-1959-1323

Scott-Snell Self-Intensifying Lamp, J. G. L., LXXVI-1960-1398

Prof. V. B. Lewes and the De Lery Light, Dr. W. H. Birchmore, A. G. L. J., LXXIII-27-1042

Hygienic Artificial Illumination, L. A. W. Alleman, A. M., M. D., P. A., XIX-1-12; 2-33

Installation of High-Pressure Gas Lighting in the Strand, J. G. L., LXXVI-1962-1518

Thermometric Effects of Welsbach Lighting in a Closed Room, J. G. L., LXXVII-1965-79

Street Lighting and Building Frontages, *Editorial*, J. G. L., LXXVII-1967-195

Regulating the Air Supply to Burners Consuming Mixed Coal and Water Gas, H. Leicester Greville, J. G. L., LXXVII-1967-205; A. G. L. J., LXXIV-6-202

Mantles Made from Lime, Herr Hans Helmecke, G. W., XXXIV-862-124

The Lighting of City Streets, E. C. Jones, A. G. L. J., LXXIV-6-203

The Position of Public Street Lights, J. G. L., LXXVII-1968-256

Incandescent Gas-Mantles Made from Lime, A. G. L. J., LXXIV-7-251

Expert Opinion on the Kitson Light, and a New Igniting Device, J. G. L., LXXVII-1969-338

The Kitson Light in England, P. A., XIX-4-75,81

High-Pressure Gas-Lighting for the Glasgow Exhibition, J. G. L., LXXVII-1970-389

Gas Supersedes Electricity at Woking, G. W., XXXIV-865-235

Light Without Heat, Prof. R. A. Fessenden, P. A., XIX-5-100

The Victory for Gas at Woking, G. W., XXXIV-866-281

Gas Lighting at the Paris Exposition, Walter S. Allen, A. G. L. J., LXXIV-9-326

Automatic Ignition of Gas, W. G. Hicks, J. G. L., LXXVII-1973-604

Relation of Heating to Lighting Power of Gas, with Special Reference to Incandescent Mantles, Herman Russell and Alfred H. White, P. A., XIX-6-118; A. G. L. J., LXXIV-13-488; J. G. L., LXXVII-1977-879

The Welsbach 1893 Patent Upheld, *Editorial*, J. G. L., LXXVII-1974-669

Gas Lighting, J. J. Knight, A. G. L. J., LXXIV-12-448

High-Pressure Gas Lighting in Manchester, G. W., XXXIV-870-445

Inaugural Address of Mr. Corbet Woodall at the Annual Meeting of the Southern District Association of Gas Engineers and Managers, J. G. L., LXXVII-1975-744

A New Method of Incandescent Gas Lighting, Herr G. Mollberg, *Summary*, G. W., XXXIV-873-550

A Combination to Test the Welsbach Patent of 1893, J. G. L., LXXVII-1979-989

The Change Occurring in the Illuminative Value of Mantles with Lapse of Time, Dr. Emil Liebenthal, J. G. L., LXXVII-1979-994; A. G. L. J., LXXIV-18-687

Mechanical Equivalent of Light, C. Hering, A. G. L. J., LXXIV-17-650

A New Method for Illuminating with Incandescent Gas-Mantles, Frederic Egner, A. G. L. J., LXXIV-19-722

High-Pressure Gas Lighting *in Excelsis*, J. G. L., LXXVII-1981-1108

Life of Incandescent Mantles, Dr. Emil Liebenthal, P. A., XIX-10-218

The Welsbach-Kern High-Pressure Burner, G. W., XXXIV-876-716

A New Incandescent Street Lamp Lighter, *Journal of Gas Lighting*,
A. G. L. J., LXXIV-21-802

Some Notes on Incandescent Gas Lighting, Ernest Fearon,
J. G. L., LXXVII-1984-1372; G. W., XXXIV-879-816;
A. G. L. J., LXXIV-23-891

The Public Lighting of Paris, J. G. L., LXXVII-1984-1376

The Kitson Light, J. G. L., LXXVII-1985-1444

The Keith Gas Compressors at Glasgow, J. G. L., LXXVII-1985-1446

The Mechanical Equivalent of Light, Carl Hering, G. W., XXXIV-880-854

The Simplification of High-Power Incandescent Gas Lighting,
J. G. L., LXXVII-1986-1503; G. W., XXXIV-881-890

Common Sense in Street Lighting, Edward B. Ellicott, P. A., XIX-12-265

Rival Lights and Their Cost, G. W., XXXIV-881-883

High and Low Pressure Gas Incandescent Lighting, William Sugg,
G. W., XXXIV-882-949; J. G. L., LXXVII-1989-1723;
A. G. L. J., LXXV-4-123

The Effect of Quality and Pressure of Gas on the Efficiency of Incandescent Gas Lighting, having Regard to Economy, Walton Grafton,
G. W., XXXIV-882-952; J. G. L., LXXVII-1989-1726;
P. A., XIX-14-298

Self-Intensifying of Gas Pressure by Means of Waste Heat, C. Scott Snell,
G. W., XXXIV-882-955; J. G. L., LXXVII-1989-1729;
A. G. L. J., LXXV-3-82

The Fischer Gas Light, J. G. L., LXXVII-1988-1672

A Wind-Proof Lantern, G. W., XXXIV-884-1037

Gases Burned in Slit and Welsbach Burners, Dr. H. Bunte,
P. A., XIX-14-308

Improvements in Welsbach Gas Lights, A. M. I. W., LXIX-3-890

Heating Power and Welsbach Value of Enriched Gas, M. Verdier,
G. W., XXXV-887-87

Mechanical Equivalent of Light, Carl Hering, P. A., XIX-15-328

The Competition with the Welsbach Company's New Mantle,
J. G. L., LXXVIII-1993-199

Improved Lighting at Herne Bay, G. W., XXXV-889-175

Supply of Petroleum for Wickless Lamps, J. G. L., LXXVIII-1994-272

Evolution: Old Lamps and New for Railway Station Lighting,
J. G. L., LXXVIII-1998-500

The Welsbach "Patent" of 1893, J. G. L., LXXVIII-1998-508

Some Adjustable Gas-Brackets for Workshop Use,
J. G. L., LXXVIII-1999-570

Automatic Lighting and Extinguishing Apparatus, M. A. Rothenbach,
G. W., XXXV-894-361; J. G. L., LXXVIII-2002-777

HEATING.

CONSUMPTION OF GAS AND APPLIANCES THEREFOR.

A Tool Room Gas Heating Furnace, A. G. L. J., LXXIII-16-609
Testing Gas Heaters, M. Auguste Levy, *Abstract*, G. W., XXXIII-846-506
Cooking by Gas, M. Auguste Levy, *Abstract*, G. W., XXXIII-846-509
Heating and Cooking by Gas, M. Auguste Levy,
J. G. L., LXXVI-1956-1146; P. A., XVIII-24-536
The Use of the Hygrometer in Studies of Ventilation,
J. G. L., LXXVI-1958-1261
The Fitting and Use of Gas Water-Heaters for Baths,
J. G. L., LXXVII-1968-262
The Prospects of Gas-Fires, J. G. L., LXXVII-1969-323
The Alleged Dryness of Air in Rooms Warmed by Gas-Fires,
Thomas Fletcher, J. G. L., LXXVII-1970-396; G. W., XXXIV-865-229
Gas Fires, Thomas Fletcher, J. G. L., LXXVII-1970-403
Central Station Heating, William H. Bryan, P. A., XIX-5-93
The Radiant Heat from Different Varieties of Gas Fires, Thomas Fletcher,
G. W., XXXIV-867-310; J. G. L., LXXVII-1973-605
Standard Requirements for Heating, P. A., XIX-6-125
Composition and Merits of Gaseous Fuel, F. J. Rowan, P. A., XIX-7-149
Business Outside the Usual Channel, F. W. Stone,
A. G. L. J., LXXIV-16-602
Little Economies of the Gas Range. Mary Dawson, P. A., XIX-18-392
The Clamond Gas Radiator, G. W., XXXV-896-456

POWER.

CONSUMPTION OF GAS AND APPLIANCES THEREFOR.

Donkin on the Gas-Engine, J. G. L., LXXVI-1951-831
A 600 Horse-Power Two-Stroke Cycle Gas Engine Using Blast Furnace Gas,
E. Meyer, *Abstract Engineering News*, P. A., XVIII-20-442
Gas Motors and Their Sources of Gas Supply, Dr. Aime Witz, *Abstract*,
G. W., XXXIII-847-548; P. A., XVIII-21-466
Gas Engines, *Machinist*, A. G. L. J., LXXIII-19-729
Gas vs. Steam Engines as Electric Power Producers,
J. G. L., LXXVI-1954-1008
Diesel's Motor at Paris, A. M. I. W., LXVII-21-391
The Bánki Gas Motor, J. G. L., LXXVI-1958-1265
A Gas Engine Electric Lighting Plant in a Public Library Building,
Engineering News, A. G. L. J., LXXIII-24-929
A Large Gas Engine, J. G. L., LXXVI-1959-1328
The Oechelhaeuser Blast Furnace Gas Engine,
A. G. L. J., LXXIII-25-963
Gas Power Electric Plant at Clausthal, Prussia,
A. G. L. J., LXXIII-25-966

An Electric Lighting Plant for Residence Service, *Engineering Record*,
A. G. L. J., LXXIII-25-967

Gas Engines and Electric Power Plants,
J. G. L., LXXVI-1961-1448; 1962-1506

The Bánki and Diesel Motors in Paris, J. G. L., LXXVI-1962-1507

Power Gas and Large Gas Engines for Central Stations, Herbert A. Humphrey,
J. G. L., LXXVI-1962-1509; LXXVII-1967-206; 1970-398;
G. W., XXXIII-857-932; XXXIV-865-239

The Gas Engine at the Beginning of the Twentieth Century, J. D. Lyon,
A. M. I. W., LXVIII-1-10

Gas Still the Cheaper Fuel, A. J. Hollis, A. M. I. W., LXVIII-1-13

Motive Power from Blast-Furnace Gases, J. G. L., LXXVI-1963-1575

The Proper Fuel Rating for Gas Engines, J. G. L., LXXVI-1963-1577

Gas Engine Built on Same Lines as Steam Engine,
A. M. I. W., LXVIII-4-106

Crossley Gas Engines and Pierson Gas Producers at the Cassel Tramways,
Engineering News, A. G. L. J., LXXIV-5-164

Greater Economy of Gas Engines as Compared with Steam Engines,
Herbert A. Humphrey, A. M. I. W., LXVIII-6-164

Unreliability of the Gas Engine, A. M. I. W., LXVIII-6-188

Vibration of the Ground through Gas Engines, J. G. L., LXXVII-1971-458

A Test of a Gas Engine Electric Lighting Plant, H. N. Cheney,
A. G. L. J., LXXIV-10-362

The Tallest Chimney in the World, J. G.. L., LXXVII-1974-677

Blast Furnace Gas Blowing Engine, *The Engineer*,
A. M. I. W., LXVIII-16-490

The Diesel Engine in England, J. G. L., LXXVII-1978-938

The Diesel Oil Engine, *London Engineering*, A. M. I. W., LXVIII-17-523

Lecture to Columbia Students on the Gas Engine, Wm. P. Flint,
A. M. I. W., LXVIII-18-545

Power Gas in France, Pierson System, J. G. L., LXXVII-1979-990

Oil Engine Trials at Cardiff, A. G. L. J., LXXV-2-46

The Buffalo Tandem Gas Engine, A. G. L. J., LXXV-12-442

RESIDUALS,

INCLUDING MATTERS RELATING TO ALL PRODUCTS OF A GAS UNDERTAKING OTHER THAN GAS.

The Production and Manufacture of Cyanides in Gas Works, Dr. Bueb,
A. G. L. J., LXXIII-15-564; G. W., XXXIII-847-549

A Furnace for Burning Coke Dust, J. G. L., LXXVI-1951-833

Coke-Fired Motor-Vans Successful, J. G. L., LXXVI-1952-896

Sulphate Making at Preston,
G. W., XXXIII-847-539; P. A., XVIII-23-527

The Preservative Virtue of Creosote, J. G. L., LXXVI-1954-1022

Professor Lunge on Coal Tar and Ammonia,
J. G. L., LXXVI-1959-1325; 1960-1392;
A. G. L. J., LXXIII-25-962; 26-1010

Mr. F. J. R. Carulla, F. C. S., on the Valuation of Gas Liquor,
J. G. L., LXXVI-1950-1397; LXXVII-1972-542
Tar Macadam Roads in Canada, J. G. L., LXXVI 1962-1507
Sulphate in 1900, G. W., XXXIV-864-200
Tar and Coke, *Editorial,* P. A., XIX-6-109
Specification for Tarred Macadam Roadways, P. A., XIX-7-147
How to Lay Tar Macadam, W. C. Wingate, A. G. L. J., LXXIV-15-571
Arsenic in Coke, Fred. E. Cooper, J. G. L., LXXVII-1979-1004
Philip Moon, J. G. L., LXXVII-1980-1061
An Analysis of Leeds Gas Liquor, Arthur W. Cooke,
J. G. L., LXXVII-1980-1067; A. G. L. J., LXXIV-18-692;
G. W., XXXIV-874-594
Coal Tar for Paving Uses, Fred. J. Warren, A. G. L. J., LXXIV-17-648
Noxious Vapours from Tar Distillation (Extract), John Craven & W. H. Coleman, G. W., XXXIV-874-592
The Manufacture of Coke, Edward W. Parker, P. A., XIX-10-208
Coke for Heating Hot-Houses on the Large Scale,
J. G. L., LXXVII-1985-1442
The Commercial Analysis of Coke, J. G. L., LXXVII-1985-1442
Arsenic in Coal and Coke,
J. G. L., LXXVII-1988-1670; A. G. L. J., LXXV-2-52;
G. W., XXXIV-883-1000
Results with Tar Macadam at Hamilton, Ont., Fred. J. Warren,
P. A., XIX-13-287
Ammoniacal Liquor as an Insecticide, J. G. L., LXXVIII-1992-142
The Treatment of Waste Gases in Sulphate Manufacture,
G. W., XXXV-887-91
Derivatives of Coal-Tar, P. A., XIX-16-346
Water-Gas Tar as a Boiler Fuel,
G. W., XXXV-892-284; A. G. L. J., LXXV-14-530
Screening Plant at Brighton Gas-Works, J. G. L., LXXVIII-1997-445
The Development of Bituminous Pavements, F. J. Warren,
A. G. L. J., LXXV-12-450

CHEMICAL,

INCLUDING TESTING AND ANALYSIS OF MATERIAL AND PRODUCTS AND GENERAL CHEMICAL NOTES RELATING TO GAS MATTERS.

Dr. Haldane's Blood Test for Carbonic Oxide in Air or Gases,
J. G. L., LXXVI-1953-948
The Estimation of Prussian Blue in Spent Oxide and of Cyanogen in Gas, Dr. A. O. Nauss, J. G. L., LXXVI-1953-960
Estimation of Sulphuretted Hydrogen in Gas, Herr A. Müller,
J. G. L., LXXVI-1956-1149
On the Estimation of Sulphuretted Hydrogen in Coal Gas, H. Leicester Greville, J. G. L., LXXVI-1958-1264
The Determination of Carbonic Oxide in Gas, J. G. L., LXXVI-1961-1957

Improvement in Orsat Apparatus, A. Bement, A. G. L. J., LXXIV-10-372

Mr. L. G. Barber on Analytical Tests in a Gas-Works Laboratory,
J. G. L., LXXVII-1974-683; G. W., XXXIV-869-405

The Quantitative Estimation of Hydrogen Sulphide in Illuminating Gas,
C. C. Tutwiler, A. G. L. J., LXXIV-17-647

Compounds of Carbonic Oxide with Iron, and their Importance with Regard to
Water Gas, J. G. L., LXXVII-1984-1371

A New Test for Sulphur in Benzol in Gas Works, Wilfrid Irwin,
G. W., XXXIV-882-909; J. G. L., LXXVII-1988-1670

On the Determination of Hydrogen in Gas Mixtures. Francis C. Phillips,
P. A., XIX-14-311

The Oxidation of Nitrogen as a Source of Error in the Estimation of Hydrogen
and Methane, A. H. White, A. G. L. J., LXXV-6-209

Estimating Nitrogen in Sulphate of Ammonia, M. Fabre,
J. G. L., LXXVIII-1996-391

Estimation of Phosphorus and Sulphur in Acetylene and Other Combustible
Gases, J. G. L., LXXVIII-1998-516

Analysis of Ammoniacal Liquors, J. G. L., LXXVIII-2001-729

PHYSICAL,

AND GENERAL TECHNICAL MATTERS RELATING TO LABORATORY PRACTICE AND RESEARCH BEARING UPON THE GAS INDUSTRY.

A New Coal Calorimeter, W. S. Parr, A. G. L. J., LXXIII-15-565

Heating and Lighting Power of Coal Gas, T. Fairley,
A. G. L. J., LXXIII-18-688; P. A., XVIII-20-443

Thermic Reactions in the Gas Retort, M. Euchene, G. W., XXXIII-854-822

The Specific Heat of Gases at High Temperatures, J. G. L., LXXVI-1960-1394

Physical and Chemical Effects of Artificial Illuminants,
J. G. L., LXXVII-1981-1120

Heating Values and Flame Temperature, G. W., XXXV-892-284

PHOTOMETRY,

MATTERS RELATING TO DETERMINATION OF ILLUMINATING POWER.

The Harcourt 10-Candle Power Pentane Lamp, Rollin Norris,
A. G. L. J., LXXIII-19-724; P. A., XVIII-22-490;
J. G. L., LXXVI-1959-1338

The Edgerton Standard, Alten S. Miller,
A. G. L. J., LXXIII-20-762; P. A., XVIII-22-491;
J. G. L., LXXVI-1959-1339

Violle on Contemporary Photometry,
J. G. L., LXXVI-1955-1075; A. G. L. J., LXXIII-21-805

More Work with the Portable Photometer, J. G. L., LXXVII-1970-483

Illuminating Power of London Gas—Tests by the Portable Photometer,
J. G. L., LXXVII-1970-413

The New Table Photometer and Pentane Ten-Candle Lamps, Prof. Frank Clowes, G. W., XXXIV-882-972; J. G. L., LXXVII-1988-1648; A. G. L. J., LXXV-1-2
A "Double-Standard" Photometer and a Calorimeter Development, J. G. L., LXXVII-1980-1751
The Depreciation of the Candle Unit, J. G. L., LXXVIII-1990-565

MANAGEMENT.

BUSINESS MANAGEMENT AND GENERAL POLICY OF GAS UNDERTAKINGS.

Profit-Sharing in France, J. G. L., LXXVI-1951-827
Systematic Keeping of Gas Companies' Accounts, J. G. L., LXXVI-1951-831
The Unprofitable Consumer, Norton H. Humphrys, J. G. L., LXXVI-1951-845; A. G. L. J., LXXIII-17-643
Methods of Giving Stokers an Interest in their Work, T. [illegible], J. G. L., LXXVI-1951-839; 1952-875; P. A., XVIII-21-400
The Problem of the British Gas Engineering Profession, *Editorial*, J. G. L., LXXVI-1953-954
Popularizing Gas, P. A., XVIII-20-448
Stokers' Wages—Board of Trade Report, G. W., XXXIII-846-504; 847-549
The Use of Cards for Records and Accounts, Wm. C. Anderson, A. G. L. J., LXXIII-26-768; P. A., XVIII-23-515
An Elaborate System of Records for a Lighting Company, J. L. Clough, A. G. L. J., LXXIII-20-771
Making an Engineer's Note-Book, J. G. L., LXXVI-1955-1159
Glasgow Corporation Gas Supply—Proposed Reduction of Illuminating Power and Superannuation of Gas Workers, J. G. L., LXXVI-1956-1158
Gas Advertising, F. W. Frueauff, A. G. L. J., LXXIII-20-767; P. A., XVIII-23-513
Introducing Gas-Stoves, John A. Britton, P. A., XVIII-23-523
Sunday Labour in Gas Works, R. G. Shadbolt, G. W., XXXIII-854-815; J. G. L., LXXVI-1959-1329
The Conviction of the Auditors of Dumbell's Bank, J. G. L., LXXVI-1960-1391
Mr. W. J. Dibdin on the Effect of Quality on the Consumption of Coal Gas, A. G. L. J., LXXIII-26-1004; P. A., XIX-1-4
J. G. L., LXXVI-1960-1395; 1961-1452
Editorial, J. G. L., LXXVI-1961-1442,
H. Grafton, J. G. L., LXXVI-1962-1524;
John T. Sheard, G. W., XXXIV-861-85
Uniform Accounting, Allen Ripley Foote, P. A., XIX-1-6
The Effect of Excessively High Wages on the Labourer, J. G. L., LXXVII-1066-133
Bookkeeping for Gas Works, Charles Sondell, G. W., XXXIV-861-87; 862-120; 863-158; 864-196; 865-231; 866-278; 868-359; 869-401; 870-437; P. A., XIX-4-68; 5-79; 6-123; 7-146; 8-169

Uniformity and Auditing of Public Accounts, Harry B. Henderson, P. A., XIX-3-57

The Duties of Auditors, J. G. L., LXXVII-1967-200

Coal Gas; Effect of Quality on Consumption, Robert Watson, J. G. L., LXXVII-1967-215

Mr. W. H. Lever on Profit-Sharing, J. G. L., LXXVII-1968-260

Workmen's Insurance in Germany, J. G. L., LXXVII-1968-260

Mr. Dibdin's Latest Pronouncement on the Commercial Valuation of Coal Gas, J. G. L., LXXVII-1968-274; 1969-333; A. G. L. J., LXXIV-7-245; 8-284

Welsbach Maintenance, *Editorial*, P. A., XIX-4-65

New Business, J. C. Sloan, A. G. L. J., LXXIV-9-330

Selling Gas, C. J. R. Humphreys, A. G. L. J., LXXIV-11-402; P. A., XIX-6-112

Neglected Opportunities, B. C. Cobb, P. A., XIX-6-113; A. G. L. J., LXXIV-13-486

Street Maps, Paul Challis, P. A., XIX-6-114; A. G. L. J., LXXIV-12-449

The Conduct of Business, J. G. L., LXXVII-1976-809; 1977-871

The Need of Devolution in Business, *Editorial*, J. G. L., LXXVII-1977-869

Novelty Advertising Department, Edited by B. W. Perkins, A. G. L. J., LXXIV-15-562; P. A., XIX-8-164

Efficiency Among Employes, L. F. Loree, P. A., XIX-8-168

Some Observations, Pessimistic and Otherwise, Charles R. Faben, Jr., A. G. L. J., LXXIV-14-526; P. A., XIX-8-158

The Uses of Advertisement, J. G. L., LXXVII-1980-1051

Mr. J. Young on Selling Gas, J. G. L., LXXVII-1980-1057; A. G. L. J., LXXIV-19-723

Office Handling of Complaints, P. A., XIX-9-200

Business Outside the Usual Channel, F. W. Stone, P. A., XIX-9-187

Coal and Its Combustion, J. G. L., LXXVII-1985-1440

Rules for a Drawing Office, A. W. Robinson, A. G. L. J., LXXIV-23-893

Reduction of the Standard Illuminating Power and Selling Price of South Metropolitan Gas, *Editorial*, J. G. L., LXXVII-1988-1623

Optimism and Pessimism as Tangible Business Factors, Norton H. Humphrys, J. G. L., LXXVII-1988-1667

What is the Load-Factor of a Gas-Works? J. G. L., LXXVIII-1991-75

Herr W. von Oechelhaeuser on Differential Rates for Gas, J. G. L., LXXVIII-1992-144; 1993-209; A. G. L. J., LXXV-6-203; 7-248; P. A., XIX-17-361

Editorial, J. G. L., LXXVIII-1993-195

Handling of Workmen, W. C. Redfield, P. A., XIX-15-327

Promotion of Domestic Fuel Gas Consumption, R. P. Valentine, A. G. L. J., LXXV-7-247; 8-283

Modern Methods of Distributing Gas, By Norton H. Humphrys, Asso. M. Inst. C. E., F. C. S.; J. G. L., LXXVIII-1996-391; A. G. L. J., LXXV-11-408

Uniform System of Accounts, P. A., XIX-17-365

The Relation of the Consumers to the Gas Manager, S. B. Langlands,
G. W., XXXV-892-276
On Being in Authority, J. G. L., LXXVIII-1997-439
Treating the Liquor Obtained from Washing, Scrubbing, Cooling or Condensing Carburetted Water Gas to Separate the Tar from the Water,
F. Thuman, *Patent Specification*, J. G. L., LXXVIII-1997-453
The Auditing of Gas Companies' Accounts, J. G. L., LXXVIII-1997-465
The South Metropolitan Workman-Director Scheme,
J. G. L., LXXVIII-2000-653

ELECTRICAL.

MATTERS RELATING TO THE GENERATION AND DISTRIBUTION OF ELECTRICITY.

Unutilized Comforts of Electricity, R. S. Hale, A. G. L. J., LXXIII-14-530
The Bremer Arc Lamps, A. G. L. J., LXXIII-14-531
Systems and Apparatus for Light and Power Distribution, A. P. Steinmetz,
A. G. L. J., LXXIII-15-569; 16-607
Interior Wiring, G. C. Allingham, A. G. L. J., LXXIII-21-809
Some Data as to Central Station Costs, Prof. W. D. Marks,
A. G. L. J., LXXIII-22-849
Notes on the Testing of Modern Dielectrics at High Voltages, J. Wright,
A. G. L. J., LXXIII-23-890
Some of the Requisites of Modern Lighting Generator Sets, H. G. Reist,
A. G. L. J., LXXIII-27-1050
Desirability of Using Storage Batteries in Medium Size Stations, L. G. White,
A. G. L. J., LXXIV-6-211
Electrical Illumination at the Beginning of the Twentieth Century,
Dr. Louis Bell, A. G. L. J., LXXIV-7-247
Non-Electrolytic Traction Systems, J. G. L., LXXVII-1971-958
Extension of the 40,000 Volt Lines of the Telluride Power Transmission Company in Utah, J. R. Cravath, A. G. L. J., LXXIV-9-331
The Welsbach Osmium Incandescent Electric Lamp, *Electrical World and Engineer*, P. A., XIX-8-172
Some Characteristic Electric Burnouts, *Insurance Engineering*,
A. G. L. J., LXXIV-19-730
Switchboards, T. D. Boyles, A. G. L. J., LXXIV-20-767
The Nernst Lamp, G. W., XXXIV-876-659
Notes on Electric Meter Testing, A. T. Smith, A. G. L. J., LXXIV-22-852
Arc Lighting at the Beginning of the Twentieth Century, W. H. Hillman,
A. G. L. J., LXXIV-23-891
Incandescent Lamp Economy, Guy V. Williams,
A. G. L. J., LXXV-3-92; P. A., XIX-14-310
Miscellaneous Notes of Interest to Electric Central Station Men,
W. H. Wakeman, A. G. L. J., LXXV-4-122; 7-253
A True Ground Detector, T. W. Varley, A. G. L. J., LXXV-4-130

Methods of Charging for Electrical Energy, W. A. Chamen, G. W., XXXV-886-53
The Influence of the Load-Factor on the Design and Operation of a Lighting and Power System, J. R. Robertson, A. G. L. J., LXXV-5-169
Requirements of Electricity in Manufacturing Work, W. S. Aldrich, A. G. L. J., LXXV-5-170
The Central Station Superintendent, J. H. Vail, P. A., XIX-15-324
Comparison of Methods of Secondary Distributing of Alternating Currents, J. C. Holberton, A. G. L. J., LXXV-7-245; 8-290
Practical Power Transmission, John Martin, A. G. L. J., LXXV-9-322
Some Notes on Electric Light and Power Distribution, D. W. Mead, A. G. L. J., LXXV-10-370
The Control of High Potential Systems of Large Power, E. W. Rice, Jr., A. G. L. J., LXXV-12-44
Notes on Electric Transmission of Power from Niagara Falls, A. G. L. J., LXXV-13-491
Development of the Nernst Lamp in America, A. J. Wurts, A. G. L. J., LXXV-14-528; 15-570; 16 609

ACETYLENE,

Matters Relating to Carbide of Calcium and Acetylene.

A Review of the Acetylene and Carbide Industries, J. G. L., LXXVI-1953-949
Acetylene Lighting in Bavaria, J. G. L., LXXVI-1953-962
Explosive Power of Acetylene Gas, Robert H. Fenn, P. A., XVIII-24-544
The Carbide of Calcium and Acetylene Industries in Germany, J. G. L., LXXVI-1962-1530; 1965-1592
New Uses for Calcium Carbide, *Engineer*, J. G. L.; LXXVII-1968-270
Acetylene Lighting, Chas. Bingham, J. G. L., LXXVII-1969-341; P. A., XIX-5 92
Acetylene Lighting Plants for Villages, *The Metal Worker*, A. G. L. J., LXXIV-20-770
The Failure of Calcium Carbide, J. G. L., LXXVII-1985-1441
Analysis and Purification of Acetylene, Herren A. Rossel and E. Landriset, J. G. L., LXXVII-1987-1570
The Future of Acetylene Lighting, A. G. L. J., LXXV-2-48
Acetylene Stoves and Their Application, A. J. Murdock, A. G. L. J., LXXV-3-91
Results of Practical Experiments with High-Pressure Acetylene Lighting, Harvey T. Hauer, P. A., XIX-14-306
Car Lighting by Acetylene Gas, H. E. Smith, P. A., XIX-16-341
Acetylene in Germany, G. W., XXXV-893-320

MISCELLANEOUS.

Natural Gas—Its Production and Consumption, "W. L. C." A. G. L. J., LXXIII-15-563

Presidential Address of Mr. Geo. G. Ramsdell at the Twenty-eighth Annual Meeting of the American Gas Light Association, P. A., XVIII-22-456; A. G. L. J., LXXIII-18-682; J. G. L., LXXVI-1955-1087

Inaugural Address of Mr. E. H. Millard at the Forty-seventh Half Yearly Meeting of the North of England Gas Managers' Association, J. G. L., LXXVI-1952-901; G. W., XXXIII-847-542

Review of the Gas Industry, Theodore Vautier, P. A., XVIII-20-438

The Work of the Examinations Department of the City and Guilds of London Institute, J. G. L., LXXVI-1955-1078

Education in Gas Manufacture—Communications from Teachers of Classes, G. W., XXXIII-850-652

The Science of Gas Manufacture and Other Things, *Engineer*, J. G. L., LXXVI-1956-1137

Production of Natural Gas in 1899—Extract from the Twenty-first Annual Report of the United States Geological Survey, A. M. I. W., LXVII-22-415; A. G. L. J., LXXIII-24-929

The Passing of the Century, G. W., XXXIII-856-892

Gas Matters in the United States, J. G. L., LXXVII-1964-24; A. G. L. J., LXXIV-3-82

Effect of Incandescent Gas Light on Plant Growth, J. G. L., LXXVII-1964-29

Business Sketches in America: Some Methods Worth Emulating, E. W. T. Richmond, J. G. L., LXXVII-1968-270; 1969-327

Inaugural Address of Mr. Walter R. Addicks at the Thirty-first Annual Meeting of the New England Association of Gas Engineers, A. G. L. J., LXXIV-8-283

How They Do Things on the Other Side, F. H. Shelton, P. A., XIX-5-88; A. G. L. J., LXXIV-11-407

Presidential Address of Mr. Thomas Glover at the Twenty-third Annual Meeting of the Midland Association of Gas Managers, G. W., XXXIV-866-269; J. G. L., LXXVII-1972-526

Mr. T. Berridge on the Training of a Gas Engineer, J. G. L., LXXVII-1972-536

Inaugural Address of Mr. Charles Wood at the Annual Meeting of the Manchester District Institution of Gas Engineers, J. G. L., LXXVII-1973-609; G. W., XXXIV-868-350

Presidential Address of Mr. Corbet Woodall at the Annual Meeting of the Southern District of Gas Engineers and Managers, G. W., XXXIV-869-394

Some Thoughts on Gas Supply: Interview with Mr. Thwaite, G. W., XXXIV-871-472

Informal Meeting of Scottish Gas Managers, J. G. L., LXXVII-1978-943

Mr. H. E. Jones on Modern Gas Practice, J. G. L., LXXVII-1980-1055

The Working Value of the Sun's Heat, J. G. L., LXXVII-1981-1115

Presidential Address of Mr. W. R. Herring at the Eleventh Annual Meeting of the Institution of Gas Engineers, G. W., XXXIV-876-661; J. G. L., LXXVII-1982-1194

The Gas Industry in Australia, G. W., XXXIV-877-738; 878-774

Wrinkle Department of the Western Gas Association,
Edited by F. H. Shelton, A. G. L. J., LXXIV-22-842; P. A., XIX-11-233

Presidential Address of Mr. I. C. Copley at the Twenty-fourth Annual Meeting of the Western Gas Association, P. A., XIX-11-228

Gas and Hygiene, James D. Ferrier, A. G. L. J., LXXIV-23-882; P. A., XIX-12-254; G. W., XXXIV-884-1038

A Gas Association Library, F. H. Shelton,
A. G. L. J., LXXIV-24-922; P. A., XIX-12-260

Inaugural Address of Mr. T. Ormiston Paterson at the Thirty-seventh Annual Meeting of the Incorporated Gas Institute,
J. G. L., LXXVII-1987-1558; G. W., XXXIV-882-919

Some Differences Between British and Continental Gas Engineering,
C. E. Brackenbury, A. G. L. J., LXXV-2-42

Correspondence Schools, P. A., XIX-14-301

Address of the President (Mr. John A. Britton, of Oakland, Cal.) on the Occasion of the Ninth Annual Meeting of the Pacific Coast Gas Association,
A. G. L. J., LXXV-5-162

Gas as an Aid to Ventilation, Walter Grafton, P. A., XIX-15-320

Presidential Address of Mr. W. R. Herring at the Fortieth Annual Meeting of the North British Association of Gas Managers,
G. W., XXXV-888-125; J. G., L., LXXVIII-1994-274

Irish Association of Gas Managers—The President's Address, W. A. Reid,
G. W., XXXV-891-238; J. G. L., LXXVIII-1997-447

Mechanically Intensified Combustion, J. G. L., LXXVIII-1997-445

Inaugural Address of Mr. George Livesey at the International Engineering Congress at Glasgow, J. G. L., LXXVIII-1999-560;
G. W., XXXV-894-352; A. G. L. J., LXXV-13-489

NEW PUBLICATIONS.

"A TEXT-BOOK ON GAS, OIL AND AIR ENGINES." By Bryan Donkin, M. Inst. C. E., etc. With 149 Illustrations, and Selected Tables of Trials. Third Edition. Revised and Largely Re-written. London: Charles Griffin & Co., Limited.

"JAHRBUCH FUR ACETYLEN UND CARBID." Im Auftrage des Deutschen Acetylenvereins, herausgegeben von Dr. M. Altschul, Dr. Karl Scheel, Professor Dr. J. H. Vogel. Band I, Jahrgang 1889. Halle A. S: Carl Marhold; 1900.

"THE CHEMISTRY OF THE MATERIALS OF ENGINEERING." A Handbook for Engineering Students, by A. Humboldt Sexton. Professor of Metallurgy in the Glasgow and West of Scotland Technical College. Manchester: The Technical Publishing Company, Limited; 1900.

"COAL TAR AND AMMONIA." Third and Enlarged Edition, by George Lunge, Ph.D., Professor of Technical Chemistry in the Federal Polytechnicum, Zurich. London: Gurney and Jackson; 1900.

"GAS COMPANIES' BOOKKEEPING." By John Henry Brearley and Benjamin Taylor. Large octavo (7.8x10), 295 pages, blue cloth (also morocco, gilt), boards. London, 1900. Walter King, publisher. Publisher's price, net: Cloth, 12s 6d. ($2.93); morocco, 18s. ($4.37.)

"PRACTICAL GAS-FITTING (INCLUDING GAS MANUFACTURE.)" With numerous Engravings and Diagrams, edited by Paul N. Hasluck, Editor of *Work*, and the *Building World*. London: Cassell and Co., Limited; 1900.

"MODERN METHODS OF SAVING LABOUR IN GAS-WORKS." By C. E. Brackenbury, Assoc. M. Inst. C. E. London: P. S. King & Son; 1901.

"A CATECHISM ON THE COMBUSTION OF COAL AND THE PREVENTION OF SMOKE." By William M. Barr, M. E. With 85 Illustrations. London: Sampson Low, Marston & Co; 1901.

"GAS AND COAL DUST FIRING." A Critical Review of the Various Appliances Patented in Germany for this Purpose since 1885, by Albert Pütsch; translated by Charles Salter. With 103 Illustrations. London: Scott, Greenwood and Co; 1901.

"HANDBOOK OF PRACTICAL GAS FITTING." By Walter Grafton. Octavo (5.7 x 8.2), 328 pages, 143 Illustrations, dark red cloth, boards. London, 1901. Published by B. T. Batsford. Price, delivered in U. S., $2.50.

OFFICERS

OF THE

AMERICAN GAS LIGHT ASSOCIATION.

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EDWARD G. COWDERY..............................MILWAUKEE, WIS.

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Alex. C. Humphreys	1899
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C. J. R. Humphreys	1884–91
A. B. Slater, Jr.	1892–96

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MEMBERS

OF THE

AMERICAN GAS LIGHT ASSOCIATION.

1901-1902.

(The date with each name is that of election to membership.)

HONORARY MEMBERS.

Barker, Forrest E. October 27, 1896.
Chairman of Massachusetts Board of Gas and Electric Light Commissioners, Boston, Mass., State House, Room 145.

Bunte, Dr. Hans. October 16, 1901.
Geheimer Hofrat, Professor Grossherzogliche - Badischen Technischen Hochschule, Generalsekretair des Deutschen Vereins von Gas-und Wasserfachmännern, Karlsruhe in Baden, Germany, Nowacksanlage 13.

Chandler, C. F. October 21, 1875.
51 East 54th street, New York, N. Y., Professor Columbia University and Chemist to New York Gas Light Company.

Foote, Allen R. October 17, 1894.
132 Market street, Chicago, Ill., Editor of Public Policy.

King, William. October 18, 1877.
Duke street, Liverpool, England, Engineer of Liverpool United Gas Light Co.

Livesey, George T. October 20, 1897.
M. I. C. E., etc., Chairman South Metropolitan Gas Company, Old Kent Road, London, England.

Love, E. G. October 20, 1886.
122 Bowery, New York, N. Y., Gas Examiner of New York City.

Morton, Henry. October 18. 1878.
Ph. D., Sc. D., LL.D., River and Sixth streets, Hoboken, N. J., President of Stevens Institute of Technology.

Oechelhaeuser, W. von. October 16, 1901.
Dessau, Germany, General Director of the German Continental Gas Association, Past President of the Deutsche Verein von Gas-und Wasserfächmannern.

Vautier, Th. October 17, 1900.
Le Président du Congrès International de l' Industrie du Gaz en 1900, 46, rue Centrale, Lyon (Rhône), France.

Welsbach, Dr. Carl Ritter Auer Von. October 17, 1900.
IV. Wiedner Hauptstrasse No. 69, Vienna, Austria.

Woodall, Corbet. October 20, 1897.
M. I. C. E., etc., Palace Chambers, Westminster, London, England.

ACTIVE MEMBERS.

Adams, Charles F. October 17, 1894.
Fifth and Yawhill streets, Portland, Oregon, President Portland Gas Co.

Adams, Henry C. October 20, 1886.
224 South Third street, Philadelphia, Pa., Vice-President of Westmoreland Coal Co.

Addicks, Frederick P. October 15, 1890.
52 Broadway, New York, N. Y.

Addicks, J. Edward. October 20, 1886.
1212 Real Estate Trust Company Building, Broad and Chestnut streets, Philadelphia, Pa.

Addicks, Walter R. October 15, 1890.
24 West street, Boston, Mass., Chief Engineer of Boston and Bay State Gas Co's.

Africa, Walter G. October 21, 1891.
39 Hanover street, Manchester, N. H., Treasurer and Superintendent of People's Gas Light Co.

Aldrich, W. A. October 19, 1898.
E. 301 Boone avenue, Spokane Falls, Washington, Secretary Spokane Falls Gas Light Company.

Allen, Wm. H. October 16, 1901.
575 Broad street, Newark, N. J., Commercial Agent of Essex & Hudson Gas Co.

Allyn, Horace A. October 16, 1901.
Third street, East Cambridge, Mass., Superintendent of Cambridge Gas Light Company.

Anderson, William C. October 18, 1899
101 North Main street, Port Chester, N. Y., Superintendent Port Chester District of the Westchester Lighting Co.

Andrews, J. Charles. October 19, 1898.
19th street and Allegheny avenue, Philadelphia, Pa., Superintendent of Meters, United Gas Improvement Co., Philadelphia Gas Works.

Apperson, Richard D.
Lynchburg, Va., President of the Lynchburg Gas Co., the Petersburg Gas Co., and the Columbia Gas Light Co.

Archer, Benjamin F. October 16, 1879.
319 Cooper street, Camden, N. J., President of Camden Gas Light Co.

Armington, James H. October 19, 1881.
Riverside, R. I., P. O. Box 41.

Armington, William A. October 19, 1892.
256 W. 23d street, New York, N. Y., Vice-President and Manager De Lery Light Co.

Arthur, F. M. October 18, 1899.
1706 No. Broad street, Philadelphia, Pa., Superintendent Spring Garden District of the Philadelphia Gas Works, United Gas Improvement Co.

Baehr, William A. October 17, 1900.
405 17th street, Denver, Col., Superintendent Gas Department, Denver Gas and Electric Company.

Bailey, William. October 18, 1898.
216 High avenue West, Oskaloosa, Iowa, Secretary of the Oskaloosa Gas Co.

Barret, A. H. October 16, 1878.
Sixth and Greene streets, Louisville, Ky., Engineer Louisville Gas Co.

Barrett, W. E. October 16, 1895.
13 Simpson Road, Ardmore, Pa., P. O. Drawer B., Superintendent and Secretary of the Lower Merion Gas Co.

Bartlett, Edward L. October 20, 1886.
McHenry and Scott streets, Baltimore, Md., P. O. Box 960, Mechanical Engineer of Bartlett, Hayward & Co.

Battin, H. S. October 19, 1898.
19th street and Allegheny avenue, Philadelphia, Pa., Superintendent Meter Department and Special Mains, The United Gas Improvement Company, Philadelphia Gas Works.

Battin, Isaac. October 15, 1873.
Omaha, Neb., Treasurer and Engineer of the Omaha Gas Co.

*Battin, William I. October 19 1898. October 18, 1899.
25th and Loomis streets, Chicago, Ill., Superintendent of South Station, People's Gas Light & Coke Co.

Baumgardner, John H. October 15, 1879.
129 North Queen street, Lancaster, Pa., Secretary of Lancaster Gas Light and Fuel Co.

Baxter, Isaac C. October 18, 1882.
Wayne County Bank, Detroit, Mich., President Windsor Gas Light Co., Ontario, Canada.

Baxter, Robert. October 19, 1881.
Halifax, N. S., P. O. Box 373, Manager of People's Heat and Light Co., Limited.

Baxter, William H. April 16, 1873.
201 Sycamore street, Petersburg, Va., P. O. Box 34, Superintendent of Petersburg Gas Light Co.

Bayly, C. Clay. October 17, 1900.
26th and G streets, Washington, D. C., care of Washington Gas Light Co.

Beadenkopf, George. October 21, 1891.
19 South street, Baltimore, Md., Assistant Engineer of Consolidated Gas Co.

Beadle, A. B. October 21, 1891.
N.W. cor. Broad and Arch streets, Philadelphia, Pa., Inspecting Engineer of the United Gas Improvement Co.

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* First date is that of election to membership in the Association ; second that of transfer from Associate to Active Membership.

Beal, Thaddeus R. October 21, 1891.
Newburgh, N. Y., Secretary, Treasurer and Manager of the Newburgh Light, Heat and Power Co.

Beal, William R. May 13, 1874.
350 Alexander avenue, New York, N. Y., President and Engineer of Central Union Gas Co.

Bell, Ernest William. October 17, 1900.
716 Locust street, St. Louis, Mo., Superintendent of Distribution, Laclede Gas Light Company.

Benner, Henry W. October 18, 1899.
Northampton Heights, South Bethlehem, Pa.

Benson, Fred. S. October 20, 1875.
Kent avenue, cor. of Cross street, Brooklyn, N. Y., Chief Engineer, Eastern Division of the Brooklyn Union Gas Co.

Betts, Edward. October 17, 1888.
827 Market street, Wilmington, Del., P. O. Box 999, President of Wilmington Coal Gas Co.

Bigelow, Arthur F. October 19, 1892.
540 Hamilton street, Allentown, Pa., Superintendent of Allentown Gas Co.

Bissell, West. October 20, 1897.
Fuller Building, Jersey City, N. J., Assistant Engineer of the Hudson County Gas Company.

Blake, S. N. October 16, 1901.
501 Realty Building, Elmira, N. Y., President Norwich (N. Y.) Gas & Electric Co. and Treasurer of Dansville Gas & Electric Co.

Blinks, Walter M. October 17, 1900.
Michigan City, Ind., Superintendent Michigan City Gas Light Company.

Blodget, Charles W. October 15, 1884.
20 Market Square, Providence, R. I., Engineer of the Providence Gas Co.

Boardman, Arthur E. October 15, 1884.
Brevard, N. C., Gas and Hydraulic Engineer.

Boardman, A. J. October 27, 1896.
Roberts Building, Tampa, Fla., Manager of Tampa Gas Co.

Bodine, Samuel T. October 20, 1886.
Broad and Arch streets, Philadelphia, Pa., P. O. Box 1564, Second Vice-President and General Manager of The United Gas Improvement Co.

Borgner, Cyrus. October 13, 1880.
23rd street, above Race, Philadelphia, Pa., Manufacturer of Fire Brick and Clay Retorts.

Bowen, William S. October 15, 1890.
139 28th street, Newport News, Va., P. O. Box 425, Superintendent of Newport News Gas Co.

Bowes, M. October 20, 1897.
Raleigh, N. C., Superintendent Raleigh Gas Co.

Bradley, Fred L. October 16, 1889.
99th street and Second avenue, New York, N. Y., Superintendent of 99th street station, Consolidated Gas Co.

Bradley, William H. May 12, 1875.
4 Irving place, New York, N. Y., Chief Engineer of Consolidated Gas Co.

Branch, A. H. October 19, 1892.
637 16th avenue, Denver, Col.

Bredel, Frederick. October 21, 1885.
118 Farwell avenue, Milwaukee, Wis., P. O. Box 232, Gas Engineer and Contractor.

Britton, John A. October 16, 1895.
Oakland, Cal., President of Oakland Gas Light and Heat Co.

Brown, Ernest C. October 19, 1887.
280 Broadway, New York, N. Y., Publisher of *Progressive Age*.

Brown, Rezeau B. October 27, 1896.
182 Wisconsin street, Milwaukee, Wis., Engineer Milwaukee Gas Light Co.

Brown, W. O. October 16, 1901.
Phillipsburg, N. J., Superintendent of People's Light, Heat & Power Co.

Brundrett, E. L. October 18, 1899.
1401 Arch street, Philadelphia, Pa., P. O. Box 1564, General Auditor of The United Gas Improvement Co.

Buck, David, Jr. October 18, 1899.
224 Bridge street, Phœnixville, Pa., Superintendent of the Consolidated Schuylkill Gas Company.

Buck, H. M. October 19, 1898.
Waukesha, Wis., P. O. Box 316, Superintendent of Waukesha American Gas Co.

Buckman, James. October 15, 1890.
S. E. corner 8th and Green streets, Philadelphia, Pa., Manager Bristol Gas Light Co.

Burke, James E. October 16, 1895.
Princeton, N. J., P. O. Box 637, Secretary and Treasurer of Princeton Gas Light Co.

Burrage, Albert C. October 20, 1897.
24 West street, Boston, Mass., President Boston, Roxbury, Dorchester, South Boston and Bay State (of Mass.) Gas Light Companies.

Burrage, Charles D. October 16, 1901.
24 West street, Boston, Mass.,Vice-President and Secretary of the Boston Gas Light Co., South Boston Gas Light Co., Roxbury Gas Light Co. and the Bay State Gas Co.

Burrows, C. E. October 17, 1900.
Walla Walla, Wash., Secretary and Superintendent Walla Walla Gas and Electric Company.

Bush, John F. October 17, 1900.
1118 North St. Paul street, Rochester, N. Y., Secretary Brockport Gas Light Co., Brockport, N. Y.

Bush, John S. October 17, 1883.
Westchester, New York City, N. Y.

Bush, Robert W. October 19, 1892.
12th street and Gowanus Canal, Brooklyn, N. Y., Engineer of Metropolitan Works, Brooklyn Union Gas Co.

Butterworth, C. W. October 16, 1901.
St. Albans, Vt., Superintendent of St. Albans Gas Light Co.

Butterworth, Irvin. October 16, 1889.
405 17th street, Denver, Col., Vice-President and General Manager The Denver Gas & Electric Co.

Byers, C. A. October 18, 1894.
Toledo, Ohio, Consulting Engineer of Bristol Gas Light Co.

Byrne, Thomas E. October 18, 1882.
First ave. and 55th street, Brooklyn, N. Y., Engineer of the Kings County Gas and Illuminating Co.

Cabot, John. October 19, 1884.
553 West 33d street, New York, N. Y., Manufacturer of Trays for Gas Works.

Calhoun, Robert. October 17, 1900.
401 Centre ave., Bay City, Mich., Superintendent Bay City Gas Company.

Callahan, W. P. October 19, 1881.
901 East 3rd street, Dayton, Ohio, Director of Dayton Gas Light & Coke Co.

Callanan, John M. October 18, 1899.
517 Market street, Chester, Pa., Superintendent of the Delaware County Gas Co.

Callender, Elbert P. October 17, 1894.
32 Pine street, New York, N. Y., Editor of *American Gas Light Journal.*

Capelle, George S. October 19, 1887.
827 Market street, Wilmington, Del., Vice-President of Wilmington Coal Gas Co.

Cardall, J. H. October 18, 1893.
Cor. Main and Mill streets, Memphis, Tenn., Superintendent of New Memphis Gas Co.

Carpender, William. October 27, 1896.
32 Pine street, New York, N. Y., President Kingston Gas Light Co.

Cartwright, William. April 16, 1873.
3413 Baring street, Philadelphia, Pa.

Case, Willard E. October 16, 1901.
Auburn, N. Y., Vice-President of American Light & Traction Co.

Cathels, Edmund. October 27, 1896.
Hamilton, Ont., Superintendent and Engineer of Hamilton Gas Light Co.

Cathels, Wm. M. October 19, 1898.
48 George street, Brantford, Ont., P. O. Box 270, Manager Brantford Gas Co., Ltd.

Chandler, Frank E. October 16, 1901.
Medford, Mass., President and General Manager of Malden & Melrose Gas Light Co.

Childs, Arthur E. October 16, 1901.
23 Central street, Boston, Mass., President of Delaware Gas Light Co. (Easton, Pa.)

Chollar, Byron E. October 17, 1888.
714 Locust street, St. Louis, Mo., Engineer of Laclede Gas Light Co.

Clabaugh, G. W. October 16, 1901.
Omaha, Neb., Secretary of the Omaha Gas Company.

Clahan, John J. October 19, 1898.
133 Whitney place, Buffalo, N. Y , Superintendent of People's Gas Light & Coke Co.

Clark, Thos. H. October 16, 1901.
Spencer, Mass., Superintendent of Spencer Gas Co.

Clark, Walton. October 15, 1884.
Broad and Arch streets, Philadelphia, Pa., P. O. Box 1564, General Superintendent of the United Gas Improvement Co.

Clarke, George S. October 17, 1888.
10th and Walnut streets, Kansas City, Mo., Superintendent of Kansas City, Mo., Gas Co.

Clary, Edward D. October 21, 1891.
914 North 6th street, Burlington, Iowa, Secretary and Superintendent of Burlington Gas Light Co.

Clements, John. October 19, 1898.
134 Central avenue, Salinas, Monterey Co., Cal., P. O. Box 165, Superintendent Salinas City Light & Water Co.

Cline, W. B. October 19, 1898.
457 South Broadway, Los Angeles, Cal., President and General Manager of Los Angeles Lighting Co.

Coates, John R. October 17, 1894.
23 Sparks street, Ottawa, Canada, President of Ottawa Gas Co.

Cocke, J. T. Bowdoin. October 20, 1897.
Birmingham, Ala., care Ford, Bacon & Davis.

Coffin, John A. October 20, 1886.
Duncan street, Gloucester, Mass., Superintendent and Agent of Gloucester Gas Light Co.

Coggshall, H. F. May 13, 1874.
376 Main street, Fitchburg, Mass., P. O. Box 633, General Manager and Treasurer of Fitchburg Gas & Electric Light Co.

Collins, Charles R. October 15, 1890.
Globe Building, Seattle, Wash., Consulting Engineer.

*Collins, David J. October 17, 1894. October 16, 1901.
1403 Arch street, Philadelphia, Pa., P. O. Box 1564, Sales Agent and Consulting Engineer of the United Gas Improvement Co.

Collins, Henry P. October 17, 1900.
Little Falls, N. Y., General Superintendent of Herkimer County Light & Power Co.

Collins, John. October 21, 1891.
1 Mt. William street, Port Jervis, N. Y., P. O. Box 972, Superintendent of Port Jervis Gas Co.

Cooke, Alfred S. October 18, 1899.
40 Wall street, New York, N. Y., Auditor of the Union Gas & Electric Co.

Cooper, William H. October 18, 1899.
Amsterdam, N. Y., Superintendent of Chuctanunda Gas Light Co.

Corbett, Charles H. October 18, 1882.
428 Lafayette avenue, Brooklyn, N. Y., P. O. Station G, Vice-President of Continental Iron Works.

Cosgrove, W. L. October 20, 1886.
Alabama and Broad streets, Atlanta, Ga., Secretary of Atlanta Gas Light Co.

Cowdery, Edward G. October 21, 1885.
182 Wisconsin street, Milwaukee, Wis., P. O. Box 65, General Manager of Milwaukee Gas Light Co.

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*First date is that of election to membership in the Association; second that of transfer from Associate to Active Membership.

Coyle, Patrick. October 19, 1881.
27 Arlington avenue, Charlestown, Mass., General Superintendent of Charlestown Gas & Electric Co.

Crafts, H. C. October 16, 1901.
216 Main street, Northampton, Mass., Superintendent of Northampton Gas Light Co.

Cressler, Alfred D. October 18, 1882.
Calhone and Murray streets, Fort Wayne, Ind., President and General Manager of Kerr-Murray Manufacturing Co.

Crisfield, James A. P. October 15, 1890.
Broad and Arch streets, Philadelphia, Pa., P. O. Box 1564, Engineer of Design of the United Gas Improvement Co.

Crockett, Joseph B. October 17, 1883.
415 Post street, San Francisco, Cal., President and Engineer of San Francisco Gas & Electric Co.

Cross, Philip. October 19, 1898.
405 17th street, Denver, Col., Manager New Business Department The Denver Gas & Electric Co.

Curley, Thomas. October 15, 1879.
827 Market street, Wilmington, Del., Superintendent of Wilmington Coal Gas Co.

Curran, G. W. October 16, 1901.
115 Hawthorne avenue, Yonkers, N. Y., Auditor of Westchester Lighting Co.

Curtis, Samuel Philip. October 20, 1897.
222 South 3rd street, Philadelphia, Pa., General Superintendent of the American Gas Co.

Daly, David R. October 21, 1885.
Green and Essex streets, Jersey City, N. J., Vice-President and Treasurer of J. H. Gautier & Co.

Daniels, John M. October 15, 1890.
1330 Main street, Columbia, S. C., P. O. Lock Box 152, Superintendent and Agent of the Columbia Gas Light Co.

Davies, H. W. October 17, 1900.
Keyport, N. J., P. O. Box 388, Manager and Treasurer of Standard Gas Co. of Keyport, Matawan and South Amboy, N. J.

Davis, Fred J. October 20, 1875.
74 Montgomery street, Boston, Mass., P. O. Box 1297, Constructing Engineer of Davis & Farnum Mfg. Co., Waltham, Mass.

Dawes, Beman G. October 19, 1898.
Marietta, Ohio, President and Treasurer Newark Gas Light & Coke Co. and Lansing Gas Light Co.

Dawes, Rufus C. October 17, 1900.
1611 Benson avenue, Evanston, Ill., President and Treasurer Northwestern Gas Light & Coke Company.

Dawson, Geo. H. October 16, 1901.
285 Court street, Binghamton, N. Y., Superintendent of Binghamton Gas Works.

Dell, John. October 21, 1885.
411 Olive street, St. Louis, Mo., President and General Manager Missouri Fire Brick Co.

Diall, M. N. October 18, 1876.
507 Ohio street, Terre Haute, Ind., General Manager of Citizens' Gas and Fuel Co.

Dickey, Charles H. October 17, 1883.
North and Saratoga streets, Baltimore, Md., P. O. Box 773, General Manager Maryland Meter and Mfg. Co.

Dickey, Robert R. October 19, 1881.
S. W. cor. Main and 2d streets, Dayton, Ohio, President of Dayton Gas Light & Coke Co.

Dixon, J. Alfred. October 19, 1892.
160 Broadway, New York, N. Y., Engineer of Pintsch Compressing Co.

Dixon, Robert M. October 15, 1890.
160 Broadway, New York, N. Y., 2nd Vice-President and Manager of Pintsch Compressing Co.

Doherty, Henry L. October 27, 1896.
40 Wall street, New York, N. Y., President of Madison (Wis.) Gas & Electric Co.

Dole, Charles E. October 16, 1901.
Bangor, Me., Superintendent of Bangor Gas Light Co.

Dole, Walter S. October 27, 1896.
321 Market street, San Francisco, Cal., Superintendent of the Independent Gas and Power Co.

Donahue, E. J. October 19, 1898.
N. W. Cor. Broad and Arch streets, Philadelphia, Pa., P. O. Box 1564, Engineer Assistant to Superintendent of Works, The United Gas Improvement Co.

Doty, Paul. October 27, 1896.
230 Woodward avenue, Detroit, Mich., Secretary and General Manager of Detroit City Gas Co.

Douglas, Henry W. October 21, 1891.
211 East Huron street, Ann Arbor, Mich., Manager of Ann Arbor Gas Co.

Douthirt, W. F. October 19, 1898.
40 Wall street, New York, N. Y., President of St. Joseph (Mo.) Gas Company.

Dunbar, Carl H. October 18, 1893.
167 Du Page street, Elgin, Ill., P. O. Box 1987, Superintendent of Elgin American Gas Co.

Dunbar, James W. October 17, 1894.
Sycamore and 7th streets, New Albany, Ind., Superintendent of New Albany Gas Light & Coke Co.

Dunderdale, Thos. October 19, 1898.
190 Ottawa street, Ottawa, Canada, Superintendent Ottawa Gas Company.

Dunn, Frank S. October 16, 1901.
1131 Broadway, Albany, N. Y., Superintendent of Municipal Gas Company of Albany.

Dusenberry, J. P. October 16, 1901.
Newark, N. J., Secretary of the Essex & Hudson Gas Co.

Dutton, Lewis R. October 19, 1898.
Wyncote, Pa., P. O. Box 150, Superintendent of the Jenkintown & Cheltenham Gas Company.

Dutton, R. Hayes. October 17, 1900.
Hanover, Pa., P. O. Box 202, Superintendent of The Hanover Gas Company.

Eakin, John W. October 17, 1894.
709 Ohio Levee street, Cairo, Ill., Secretary and Superintendent of Cairo City Gas Co.

Earnshaw, Edward H. October 18, 1899.
22d and Filbert streets, Philadelphia, Pa., Assistant Engineer of Works of the Philadelphia Gas Works, the United Gas Improvement Company.

Eaton, W. M. October 18, 1899.
260 E. Main street, Jackson, Mich., General Manager of the Jackson Gas Company.

Edwards, George B. October 18, 1882.
113 Chambers street, New York, N. Y., Agent of Goodwin Meter Co.

Egner, Frederic. October 16, 1899.
Norfolk, Va., Engineer with Wm. Henry White. Address care of G. H. Brown, 188 Water street, Morristown, N. J.

Eichbaum, Frederick H. October 16, 1889.
101 Devisadero street, San Francisco, Cal., Engineer and Superintendent of Pacific Gas Improvement Co.

Eilbeck, Arthur B. October 16, 1892.
40 Wall street, New York, N. Y.

Elkins, George W. October 20, 1886.
423 Walnut street, Philadelphia, Pa., Manufacturer of Coal Tar Products.

Elkins, William L., Jr. October 20, 1886.
36 Wall street, New York, N. Y., President of United Coke & Gas Co.

Elles, Edward J. October 18, 1899.
Evansville, Ind., Superintendent of the Evansville Gas and Electric Light Co.

Evans, Charles H. October 16, 1889.
300 53d street, Chicago, Ill., Engineer and General Superintendent of Mutual Fuel Gas Co.

Eysenbach, Ernest E. October 16, 1901.
Columbus, Ohio, Superintendent of Columbus Gas Company.

Faben, Charles R., Jr. October 21, 1885.
327 South Erie street, Toledo, Ohio, General Manager of Toledo Gas Light and Coke Co.

Ferrier, James. October 16, 1895.
1149 Broad Street, Columbus, Ga., P. O. Box 316, Superintendent of the Gas Light Co. of Columbus.

Findlay, J. H. October 18, 1882.
17 Franklin street, Ogdensburg, N. Y., with Kern Incandescent Gas Light Company.

Fitz, Robert F. October 15, 1890.
361 Douglas avenue, Elgin, Ill.

Flemming, Dudley D. October 13, 1880.
249 Washington street, Jersey City, N. J., Gas Engineer.

Floyd, Frederick W. October 18, 1882.
742 East 12th street, New York, N. Y., Gas Engineer of the Quintard Iron Works

Fodell, William P. October 15, 1879.
50 Laurel street, Philadelphia, Pa., Secretary and Treasurer of Northern Liberties Gas Co.

Forbes, Charles. October 16, 1901.
London, Ontario, Canada, Superintendent of City Gas Co.

Forbes, James. October 16, 1889.
619 Cherry street, Chattanooga, Tenn., Superintendent of Chattanooga Gas Light Co.

Forstall, Alfred E. October 17, 1888.
Montclair, N. J. Office address, 58 William street, New York, N. Y. Secretary of the Trustees Gas Educational Fund. Consulting Gas Engineer.

Forstall, Walton. October 16, 1895.
Broad and Arch streets, Philadelphia, Pa., P. O. Box 1564, Assistant Engineer of Distribution, Philadelphia Gas Works, United Gas Improvement Co.

Foss, Eugene N. October 19, 1892.
8 Everett street, Jamaica Plain, Mass., President of Jamaica Plain Gas Light Co.

Fowler, John. October 15, 1879.
39 Laurel street, Philadelphia, Pa., Deily & Fowler, Laurel Iron Works.

Fowler, Samuel J. October 21, 1891.
Boston, Mass., Treasurer and Agent of the Charlestown Gas and Electric Co.

Frost, William H. October 15, 1879.
11 East Wall street, Fort Scott, Kan., P. O. Box 463, President of Fort Scott Light and Fuel Co.

Frueauff, Frank W. October 17, 1900.
405 17th street, Denver, Col., Secretary Denver Gas and Electric Company.

Ganser, Herbert H. October 16, 1901.
Norristown, Pa., Superintendent of Gas Company of Montgomery County.

Gartley, Alonzo. October 19, 1898.
King and Alekea streets, Honolulu, H. I., P. O. Box 144, General Manager of Hawaiian Electric Co., Ltd.

Gartley, William H. October 21, 1885.
1401 Arch street, Philadelphia, Pa., Engineer of Works for Philadelphia, The United Gas Improvement Co.

Gates, Frederick W. May 13, 1874.
17 Herkimer street, Hamilton, Ontario, Can., President of Hamilton Gas Light Co.

Geggie, David H. October 19, 1881.
No. 2 Place d'Orleans, Quebec, Canada, P. O. Box 207, Secretary and Manager of the Quebec Gas Co.

George, Thos. L. October 18, 1899.
N. W. cor. Broad and Arch streets, Philadelphia, Pa., General Agent of the Philadelphia Gas Works, The United Gas Improvement Co.

Gerould, Charles L. October 17, 1883.
Galesburg, Ill., Manager of Galesburg Gas and Electric Light Co.

Gibbons, P. H. October 18, 1893.
2017 Morris street, Philadelphia, Pa., Main Foreman The United Gas Improvement Co.

Gibbs, W. W. October 20, 1886.
850 Drexel Building, Philadelphia, Pa., Chairman of Managing Committee, The United Gas Improvement Co.

Giblin, John A. October 21, 1891.
10 East Main street, Ilion, Herkimer Co., N. Y., P. O. Box 513, Superintendent Herkimer County Light and Power Co.

Gifford, Nathaniel W. October 21, 1891.
New Bedford, Mass., Superintendent of New Bedford Gas and Edison Light Co.

Gimper, John. October 15, 1890.
Galveston, Texas, Superintendent of Galveston Gas Co.

Glasgow, Arthur G. October 19, 1887.
38 Victoria street, London, S. W., England, Humphreys & Glasgow, London and New York.

Glass, Sheldon J. October 20, 1897.
182 Wisconsin street, Milwaukee, Wis., P. O. Box 65, Secretary and Treasurer Milwaukee Gas Light Co.

Golden, John W. October 18, 1899.
Savannah, Ga., Secretary of the Mutual Gas Light Co.

Goodnow, George F. October 16, 1901.
Waukegan, Ill., General Manager of the North Shore Gas Co.

Gould, John A. October 16, 1901.
24 West street, Boston, Mass., Chief Engineer of the Brookline and Dorchester Gas Light Companies.

Graf, Carl H. October 19, 1892.
114 Main street, Hackensack, N. J., Engineer of Gas Department of The Gas and Electric Company of Bergen County.

Graham, Malcolm Montrose. October 18, 1899.
340 Third avenue, New York, N. Y., Secretary and Treasurer of the New Amsterdam Gas Co.

Graves, Henry C. October 17, 1883.
S. W. cor. Main and 2d streets, Dayton, Ohio, Vice-President of Dayton Gas Light and Coke Company.

Green, James. October 21, 1885.
915 Wainwright Building, St. Louis, Mo., President of Sedalia Gas Co., Moberly Gas and Electric Co., and Greencastle Gas and Electric Light Co.

Greenough, Malcolm S. October 16, 1878.
356 Superior street, Cleveland, Ohio, President Cleveland Gas Light and Coke Co.

Gribbel, John. October 17, 1883.
1513 Race street, Philadelphia, Pa., of John J. Griffin & Co., Meter Manufacturers.

Guldlin, Olaf N. October 21, 1891.
157 West Berry street, Fort Wayne, Ind., President and Engineer of Western Gas Construction Co.

Gwynn, J. W. October 15, 1890.
Bucyrus, Ohio, P. O. Box 65, Manager of The Bucyrus Gas and Electric Light Co.

Hadden, James M. October 19, 1898.
Poughkeepsie, N. Y., Manager Poughkeepsie Gas Works.

Haines, Jansen. October 18, 1899.
Broad and Arch streets, Philadelphia, Pa., Gas Engineer with the United Gas Improvement Co.

Hall, Arthur H. October 19, 1898.
350 Alexander avenue, New York, N. Y., Superintendent of Distribution, Central Union Gas Co.

Hambleton, Francis H. October 17, 1888.
19 South street, Baltimore, Md., P. O. Box 288, Chief Engineer of Consolidated Gas Co.

Hamilton, Douglass. October 18, 1899.
1815 Webster avenue, New York, N. Y., Secretary and Treasurer of the Northern Union Gas Co.

Hammatt, Clarence S. October 15, 1890.
26 Main street, Jacksonville, Fla., Superintendent of Citizens' Gas and Electric Co.

Hanford, L. C. May 13, 1874.
1 Belden avenue, Norwalk, Conn., P. O. Box 402, Superintendent of Norwalk Gas Light Co.

Harbison, John P. May 13, 1874.
Hartford, Conn., President, Treasurer and General Manager Hartford City Gas Light Co.

Harper, George H. October 16, 1889.
2526 Broad avenue, Altoona, Pa., Superintendent Altoona Gas Co.

Harris, J. A. October 20, 1886.
1513 Race street, Philadelphia, Pa., with J. J. Griffin & Co., Gas Meter Manufacturers.

Hartpence, C. C. October 18, 1899.
242 Sixth avenue, Newark, N. J., Gas and Electric Engineer.

Hatstat, John W. October 27, 1896.
Hartford, Conn., Superintendent of Hartford City Gas Light Co.

Hauk, Charles D. October 21, 1885.
860 St. Nicholas avenue, New York, N. Y., Vice-President and General Manager of National Heat and Power Construction Co.

Hayward, Thomas J. October 15, 1884.
McHenry and Scott streets, Baltimore, Md., President of the Spanish American Light and Power Co., Consolidated, Havana, Cuba.

Helme, William E. October 20, 1885.
1339 Cherry street, Philadelphia, Pa., Helme & McIlhenny, Meter Manufacturers.

Herron, J. T. October 15, 1890.
186 Main street, Buffalo, N. Y., Engineer of the Buffalo Gas Co.

Hersh, Grier. October 17, 1900.
York National Bank, York, Pa., President York Gas Company.

Hickenlooper, Andrew. May 13, 1874.
4th and Plum streets, Cincinnati, Ohio, P. O. Box 719, President of The Cincinnati Gas and Electric Co.

Hicks, Richard S. October 17, 1894.
73 Warren street, New York, N. Y.

Higby, William R. October 18, 1888.
380 Main street, Bridgeport, Conn., President of Bridgeport Gas Light Co.

Highlands, S. M. October 17, 1900.
Clinton, Iowa, President and General Manager Clinton Gas Light and Coke Co.

Hill, William H. October 19, 1892.
40 Water street, Boston, Mass., P. O. Box 5282, President of Citizens' Gas Light Co., Quincy, Mass.

Hilleke, August F. October 16, 1901.
Everett, Mass., Assistant Superintendent of the New England Gas and Coke Co.

Hiramatsu, Suyekichi. October 17, 1900.
Nishikicho, Tokio, Japan, Chief Engineer Tokio Gas Co.

Hofman, G. Max. October 19, 1898.
Fort Wayne, Ind., General Superintendent Fort Wayne Gas Co.

Holden, Thos. F. October 20, 1897.
12th and M streets, S. E., Washington, D. C., Superintendent East Station Works, Washington Gas Light Co.

Holmes, Rufus E. October 18, 1899.
55 High street, Winsted, Conn., Lock Drawer D, Station A, President of the Winsted Gas Co.

Holzer, Edwin G. October 17, 1894.
Easton, Pa., Superintendent of the Delaware Gas Light Co., the Easton Gas Co. and the Easton Fuel Gas Co.

Hopper, William H. October 18, 1882.
137 West Washington lane, Germantown, Philadelphia, Pa., Director in Wausau (Wis.) Gas Light and Coke Co., Beloit (Wis.) Gas Light and Coke Co. and Gainesville (Texas) Light and Fuel Co.

Horton, Thomas O. October 18, 1899.
264 Bay street, Stapleton, S. I., N. Y., Secretary and Manager New York and Richmond Gas Co.

Hough, David Leavitt. October 19, 1892.
13–21 Park Row, New York, N. Y., President of the United Engineering and Contracting Co., of New York.

Howes, R. V. October 18, 1899.
Winston-Salem, N. C., P. O. Box 367, Superintendent of the Winston-Salem Gas and Lighting Co.

Humphreys, Alexander C. October 20, 1875.
31 Nassau street, New York, N. Y., M. E., M. Inst. C. E., etc., of Humphreys & Glasgow, President of Gas Companies, Buffalo, N. Y.

Humphreys, C. J. R. October 19, 1881.
370 Essex street, Lawrence, Mass., P. O. Drawer K, Agent of Lawrence Gas Co.

Humphreys, James J., Jr. October 19, 1898.
Worcester, Mass , Superintendent Worcester Gas Light Co.

Hunt, A. G. B. October 17, 1900.
New London, Conn., General Manager New London Gas and Electric Company.

Huntington, Ford. October 18, 1899.
340 Third avenue, New York, N. Y., Secretary and Treasurer of the New Amsterdam Gas Co.

Isbell, Charles W. May 12, 1875.
245 Broadway, New York, N. Y., President of Isbell-Porter Co., Gas Engineers and Contractors.

Jackson, Walter M. October 19, 1887.
(9 Oliver street, Stamford, Conn.) New York, N. Y., P. O. Box 808.

Jenkins, E. H. October 21, 1891.
403 East Houston street, San Antonio, Tex., President San Antonio Gas and Electric Co.

Jones, Edward C. October 15, 1879.
415 Post street, San Francisco, Cal., Engineer of San Francisco Gas & Electric Co.

Jones, T. C. October 19, 1898.
Delaware, Ohio, Superintendent and Secretary Delaware Gas Co.

Jourdan, Edward R. October 17, 1900.
4 Irving Place, New York, N. Y., Assistant General Superintendent of Mains and Services Consolidated Gas Company.

Jourdan, James H. October 21, 1891.
Nevins and Degraw streets, Brooklyn, N. Y., Chief Engineer of Western Division Brooklyn Union Gas Co.

Kellogg, L. L. October 15, 1890.
Sioux City, Iowa, Vice-President and Manager of Sioux City Gas & Electric Co.

Kempf, John, Jr. October 19, 1898.
769 Main street, Salt Lake City, Utah, P. O. Box 52, Superintendent Gas Department, Utah Light and Power Co.

Kennedy, James S. October 17, 1900.
115th street and East River, New York, N. Y., Superintendent Standard Gas Light Company.

Keppelman, John H. October 21, 1891.
20 North 5th street, Reading, Pa., P. O. Box 384, Superintendent of the Consumers' Gas Co.

Kingsbury, Frank D. May 13, 1874.
8 East Market street, Corning, N. Y., P. O. Box 884, Treasurer and General Manager of Corning Gas Co.

Klumpp, John B. October 18, 1899.
20th street and Lincoln avenue, Omaha, Neb., Superintendent of the Omaha Gas Company.

Knapp, Isaac N. October 19, 1898.
1125 South 28th street, Omaha, Neb.

Knight, C. S. October 15, 1890.
Oliver and Buchanan streets, Fort Wayne, Ind., Vice-President Siemens & Halske Electric Co.

Knight, Elmer B. October 21, 1891.
Far Rockaway, Long Island, N. Y., P. O. Box 331, Superintendent of the Town of Hempstead Gas and Electric Light Co.

Knight, J. J. October 16, 1901.
Kalamazoo, Mich., General Manager of the Kalamazoo Gas Company.

Knowles, W. P. October 27, 1896.
23 E. Canal street, Richmond, Va., Superintendent and Engineer of City Gas Works.

Konrad, Augustus. October 18, 1899.
40 No. Washington street, Tarrytown, N. Y., P. O. Box 383.

Kuehn, Jacob L. October 19, 1881.
33 East Philadelphia street, York, Pa., P. O. Box 344, Superintendent and Engineer of York Gas Co.

Lamson, Charles D. October 19, 1881.
240 Main street, Worcester, Mass., President and General Manager of Worcester Gas Light Co.

Lane, James W. October 21, 1891.
1046 West 4th street, Williamsport, Pa., Superintendent and Engineer of Williamsport Gas Co.

Langford, John T. October 17, 1883.
70 Kilby street, Boston, Mass., Contracting Engineer.

Lathrop, A. P. October 18, 1899.
N. W. cor. 6th and Jackson streets, St. Paul, Minn., President and General Manager St. Paul Gas Light Co.

Lawrence, W. F. October 19, 1898.
Long Island City, N. Y., care of New Amsterdam Gas Co., Ravenswood Works.

Leach, Henry B. October 18, 1882.
68 Washington street. Taunton, Mass., P. O. Box 76 Agent and Treasurer of Taunton Gas Light Co.

Learned, Charles A. October 27, 1896.
40 Colony street, Meriden, Conn, P. O. Box 575, Superintendent and Manager of Meriden Gas Light Co.

Learned, Everett C. October 19, 1881.
118 Maple street, New Britain, Conn., P. O. Box 355, Superintendent of New Britain Gas Light Co.

Learned, Waldo A. October 18, 1882.
2 Jewett street, Newton, Mass., General Superintendent of Newton & Watertown Gas Light Co.

Leetch, John. October 17, 1894.
1409 31st street, Washington, D. C., General Manager of Washington Gas Light Co.

Leonard, Charles F. October 18, 1899.
Fall River, Mass., Assistant Superintendent of the Fall River Gas Works Co.

Light, George. October 16, 1901.
205 East 1st street, Dayton, Ohio, Assistant Superintendent of the Dayton Gas Light and Coke Co.

Light, Joseph. Oct. 21, 1885.
203 East 1st street, Dayton, Ohio, Engineer and Superintendent of Dayton Gas Light & Coke Co.

Lillie, Lewis. October 21, 1891.
N. W. cor. Broad and Arch streets, Philadelphia, Pa., Secretary and Treasurer of the United Gas Improvement Co.

Linton, S. E., Jr. October 16, 1901.
Sag Harbor, N. Y., Superintendent of the Sag Harbor Gas Works, The United Gas Improvement Co.

Little, F. W. October 20, 1897.
125 North Jefferson avenue, Peoria, Ill., Vice-President, Peoria Gas and Electric Company.

Littlehales, Thomas. May 13, 1874.
715 East Genesee street, Syracuse, N. Y.

Littlehales, Thomas G. October 19, 1898.
Hopkinsville, Ky., P. O. Box 284, Lessee and Manager Hopkinsville Gas & Lighting Co.

Lloyd, John. October 27, 1896.
First Nat'l Bank, Altoona, Pa., President of Altoona Gas Co.

Logan, John D. October 18, 1893.
Brooklyn, E. D., N. Y., P. O. Box 6, Station G, Vice President of Greenpoint Gas Light Co.

Logan, William J. October 19, 1892.
Brooklyn, E. D., N. Y., P. O. Box 6, Station G, Proprietor of Logan Iron Works.

Loomis, Burdett. October 15, 1884.
Hartford, Conn., Builder of Water Gas Works.

Lowe, Thaddeus, S. C. October 20, 1886.
Pasadena, Cal.

Ludlam, Edwin. October 15, 1873.
180 Remsen street, Brooklyn, N. Y., Secretary of Brooklyn Union Gas Co.

Lynch, Eugene T. October 16, 1895.
Detroit, Mich., President of Detroit Gas Co.

Lynn, James T. October 17, 1883.
301 Wayne Bank Building, Detroit, Mich., Gas Engineer.

McCleary, Alexander J. October 17, 1888.
22nd and Filbert streets, Philadelphia, Pa., Superintendent Street Lighting Department of the Equitable Illuminating Gas Light Co.

McCullough, Edmund H. October 18, 1882.
224 South 3rd street, Philadelphia, Pa., President of Westmoreland Coal Co.

Macdonald, Benjamin J. October 15, 1890.
296 Grand street, Newburg, N. Y.,President and Treasurer of the Bristol Gas & Electric Co., Bristol, Tenn.

MacDonald, William. October 16, 1889.
Point Breeze, Philadelphia, Pa., Superintendent Station G, United Gas Improvement Co.

McDonald, William. October 15. 1879.
51 Lancaster street, Albany, N. Y. D. McDonald & Co., Meter Manufacturers.

McIlhenny, James S. October 15, 1890.
26th and G streets, N. W., Washington, D. C., Superintendent of Washington Gas Light Co.

McIlhenny, John. May 12, 1875.
1339 Cherry street, Philadelphia, Pa., Helme & McIlhenny, Meter Manufacturers.

McIlhenny, John D. October 16,1895.
1339 Cherry street, Philadelphia, Pa., President of Citizens' Gas & Fuel Co., Terre Haute, Ind.

McKay, William E. October 19, 1892.
10 Pearl street, Dorchester, Mass., Engineer in charge Bay State Gas Works, Bay State Gas Co., Boston, Mass.

McKeige, Ferdinand. October 15, 1890.
Address Unknown.

McKenzie, W. H. October 17, 1900.
Sioux Falls, South Dakota, Superintendent Sioux Falls Gas Light Company.

McLean, George. October 19, 1898.
669 Main street, Dubuque, Iowa, P. O. Drawer 328, Secretary Key City Gas Co.

McLean, John R. October 17, 1894.
413 10th street, N. W., Washington, D. C., President of Washington Gas Light Co.

MacMillan, George. October 21, 1891.
761 Lawrence street, Appleton, Wis., P. O. Box 28.

McMillin, Emerson. May 13, 1874.
40 Wall street, New York, N. Y., President of Columbus Gas Light & Coke Co., Laclede Gas Co., Milwaukee Gas Co., Grand Rapids Gas Co. and Consolidated Gas Co. of New Jersey, etc.

Macmun, G. F. October 16, 1901.
Marlboro, Mass., General Manager of the Marlboro Gas Light Co.

Manier, Robert W. October 18, 1899.
30 Chenango street, Binghamton, N. Y., P. O. Box 653, Treasurer of the Binghamton Gas Works.

Mann, Howard E. October 17, 1900.
Foot of Willson avenue, Cleveland, Ohio, Superintendent of Works No. 2, Cleveland Gas Light & Coke Company.

*Mansur, John H. October 17, 1894. October 16, 1901.
Royersford, Pa., President of the Consolidated Schuylkill Gas Co.

Marani, Virgil G. October 20, 1897.
356 Superior street, Cleveland, Ohio, Assistant Engineer and Civil Engineer Cleveland Gas Light & Coke Co.

Marks, William D., Ph. B., C. E. October 17, 1900.
Fostoria, Ohio, President City Heat & Light Company.

Max, William J. October 20, 1897.
153 Wickham avenue, Middletown, N. Y., Superintendent Orange County Gas & Electric Co.

Mayer, Frederick J. October 15, 1884.
McHenry and Scott streets, Baltimore, Md., Engineer with Bartlett, Hayward & Co.

Mayers, J. Alex. October 19, 1898.
32 Pine street, New York, N. Y., Gas Engineer.

Maynard, H. B. October 17, 1900.
Ottumwa, Iowa, Manager and Treasurer Ottumwa Gas Light, Heat & Power Company.

Merrifield, L. L. October 19, 1898.
157 Dowling avenue, Toronto, Canada, Gas Engineer Canadian Gas Association.

Merritt, Charles H. October 15, 1879.
350 Main street, Danbury, Conn., President of Danbury and Bethel Gas and Electric Light Co.

Middleton, Robert L. October 17, 1894.
1411 30th street, N. W., Washington, D. C., Superintendent of Georgetown Gas Light Co.

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*First date is that of Election to Membership in the Association; second that of transfer from Associate to Active Membership.

Miller, Alten S. October 16, 1889.
4 Irving place, New York, N. Y., Assistant Engineer of the Consolidated Gas Co.

Miller, Carroll. October 18, 1899.
Room 373, The Rookery, Chicago, Ill., Consulting Engineer.

Miller, C. O. G. October 21, 1891.
455 Sutter street, San Francisco, Cal., President of Pacific Gas Improvement Co., also President of Pacific Lighting Co.

Miller, Ira Abbot. October 17, 1900.
104 N. Tejon street, Colorado Springs, Col., Secretary Colorado Springs Light and Power Company.

Miller, William A. October 27, 1896.
2817 Eastern avenue, Cincinnati, Ohio, Superintendent of Manufacture, Cincinnati Gas and Electric Co.

Milsted, William N. October 19, 1887.
11th avenue and 47th street, New York, N. Y., Secretary of American Meter Co.

Mitchell, Kerr M. October 16, 1889.
516 Francis street, St. Joseph, Mo., General Manager of St. Joseph Gas Co.

Molony, Martin. October 18, 1899.
37th and Market streets, Philadelphia, Pa., Superintendent West Philadelphia District, Philadelphia Gas Works, The United Gas Improvement Co.

Moore, Northrop. October 19, 1898.
Husted Building, Kansas City, Kansas, Superintendent Wyandotte Gas Co.

Morgans, William H. October 19, 1887.
11 So. Saginaw street, Pontiac, Mich., Manager and Treasurer of Pontiac Gas and Electric Co.

Morrell, Edward E. October 20, 1897.
221 Wesley avenue, Oak Park, Ill., Gas Engineer.

Morris, Henry G. October 15, 1879.
408 Philadelphia Bourse, Philadelphia, Pa., Engineer and Machinist.

Morris, W. Cullen. October 18, 1899.
Ravenswood, Long Island City, N. Y., Superintendent of the Ravenswood Works of the New Amsterdam Gas Co.

Morrison, H. K. October 19, 1898.
5 Capitol street, Concord, N. H., Superintendent Concord Light and Power Co.

Morton, Frederick N. October 16, 1895.
Clinton avenue and 13th street, Hoboken, N. J., Superintendent of Hoboken District of Hudson County Gas Co.

Moses, Frank D. October 17, 1894.
222 East State street, Trenton, N. J., P. O. Box 235, Chief Engineer of Trenton Gas and Electric Co.

Moses, George W. October 13, 1880.
Chelsea, Mass., P. O. Box 28, Treasurer and General Manager of Chelsea Gas Light Co.

Motley, George S. October 16, 1901.
Lowell, Mass., Treasurer of the Lowell Gas Light Co.

Nettleton, Charles H. October 20, 1875.
Derby, Conn., P. O. Drawer L, President of Derby Gas Co., President New Haven Gas Light Co.

Nix, Joshua J. October 16, 1895.
353 Church street, Royersford, Pa., P. O. Box 158, Lessee of Spring City and Royersford Gas Light Co.

Norcross, J. A. October 27, 1896.
38 Victoria street, London, S. W., England, Manufacturing Expert, Humphreys & Glasgow.

Norcross, J. C. October 18, 1899.
Spartanburg, S. C., Superintendent of Spartanburg Railway, Gas and Electric Co.

Norris, Rollin. October 16, 1889.
Broad and Arch streets, Philadelphia, Pa., P. O. Box 1564, Superintendent of Works of the United Gas Improvement Co.

Norton, Walter F. October 19, 1898.
9 Courtland street, Nashua, N. H., P. O. Box 275, Superintendent Nashua Light, Heat and Power Co.

Nute, Joseph E. October 17, 1888.
14 Bedford street, Fall River, Mass., P. O. Box 66, Superintendent of Fall River Gas Works Co.

Nutting, Charles H. October 18, 1899.
8 Springfield street, Chicopee, Mass., P O. Box 1221, Superintendent of Chicopee Gas Light Co.

Old, George. October 16, 1901.
St. Augustine, Fla., Superintendent of the St. Augustine Gas and Electric Light Co.

Page, Carter H., Jr. October 18, 1893.
N. W. cor. Broad and Arch streets, Philadelphia, Pa., P. O. Box 1564, Commercial Agent of the United Gas Improvement Co.

Park, William K. October 21, 1885.
22d and Filbert streets, Philadelphia, Pa., Consulting Engineer at the Philadelphia Gas Works, the United Gas Improvement Co.

Parker, Richard Marsh. October 19, 1898.
186 Main street, Buffalo, N. Y., Assistant Secretary Buffalo Gas Co.

Parker, T. R. October 19, 1898.
Napa, Cal., General Manager Napa City Gas Light and Heating Co.

Paullins, William C. October 18, 1899.
104 N. Tejon street, Colorado Springs, Col., Superintendent of Colorado Springs Light and Power Co.

Pearson, William H. October 20, 1875.
19 Toronto street, Toronto, Ont., General Manager and Secretary of Consumers' Gas Co.

Pearson, William H., Jr. October 17, 1888.
95 Isabella street, Toronto, Ont., Engineer and Superintendent of Consumers' Gas Co.

Pelton, Frank Kerr. October 18, 1899.
301 Wayne County Bank Building, Detroit, Mich., Secretary and Treasurer of the Bowling Green Gas Company, Bowling Green, Ohio.

Perkins, James D. October 18, 1882.
228 Produce Exchange, New York, N. Y., President of the Perkins' Co., Gas Coal Dealers.

Pinkney, Edward A. October 21, 1891.
217 Genesee street, Utica, N. Y., General Manager and Treasurer of Equitable Gas and Electric Co.

Planck, J. W. October 18, 1899.
3 First street, Ilion, N. Y., P. O. Box 414, Superintendent Gas Department, Herkimer Light and Power Co.

Pollitt, L. I. October 16, 1901.
Pine Bluff, Ark., Manager of the Pine Bluff Light and Water Co.

Poole, John H. October 17, 1900.
405 17th street, Denver, Col.

Poor, Frank B. October 27, 1896.
185 Main street, Hackensack, N. J., President of The Gas and Electric Co. of Bergen County.

Porter, Joseph F. October 27, 1896.
205 Market street, Alton, Ill., President and Managing Engineer of Alton Railway, Gas and Electric Co.

Powers, Edgar J. October 16, 1901.
Lincoln, Neb., General Manager of the Lincoln Gas & Electric Co.

Pratt, Edward G. October 20, 1886.
413 Locust street, Des Moines, Iowa, President and Manager of Capital City Gas Light Co.

Prichard, Charles F. October 17, 1883.
90 Exchange street, Lynn, Mass., General Manager of Lynn Gas & Electric Co.

Printz, Eugene. May 13, 1874.
North 6th street, Zanesville, Ohio, Superintendent of Zanesville Gas Light Co.

Purcell, T. V. October 17, 1900.
Ashland Block, Chicago, Ill., General Manager of the Ogden Gas Co.

Quinn, Andrew K. October 19, 1887.
181 Thames street, Newport, R. I., P. O. Box 305, Treasurer of Newport Gas Light Co.

Ramsdell, George G. October 15, 1879.
395 Broadway, New York, N. Y., General Manager of the Connelly Iron Sponge & Governor Co.

Randolph, William W. October 17, 1894.
31 Nassau street, New York, N. Y., Engineer Humphreys & Glasgow.

Rawn, John C. October 21, 1891.
Cor. Church avenue and Henry street, Roanoke, Va., P. O. Drawer 749, Manager and Engineer Roanoke Gas & Water Co.

Raynor, Charles H. October 15, 1873.
9 North Winter street, Adrian, Mich., Secretary of Adrian Gas Co.

Reichelt, A. F. October 20, 1897.
350 Alexander avenue, New York City.

Reilly, John W. October 21, 1891.
116 South 6th street, Wilmington, N. C., Superintendent of Wilmington Gas Light Co.

Rice, Henry L. October 17, 1894.
Norfolk, Va., Superintendent City Gas Co. of Norfolk and Engineer Gas Department, Railways and Light Company of America.

Richardson, Frank S. October 19, 1881.
84 Main street, North Adams, Mass., P. O. Box E, Vice-President, Treasurer and Manager of North Adams Gas Light Co.

Riege, Rudolph. October 18, 1899.
300 Liberty street, Penn Yan, N. Y.

Ringwood, Thomas. October 15, 1890.
4 Armory street, Ilion, Herkimer County, N. Y., P. O. Box 1023, President of Ilion and Mohawk Gas Light Co.

Riselay, William S. October, 18, 1899.
188 Main street, Buffalo, N. Y., Secretary and Treasurer of Buffalo Gas Companies, and People's Gas Light Co. of Buffalo

Roberts, George J. October 17, 1894.
Broad and Arch streets, Philadelphia, Pa., P. O. Box 1564, Gas Engineer with the United Gas Improvement Co.

Robison, C. D. October 17, 1900.
Auburn, N. Y., Superintendent and Treasurer Auburn Gas Light Co.

Rogers, W. H. October 17, 1894.
146 Ellison street, Paterson, N. J., P. O. Box 1914, Secretary of the Paterson and Passaic Gas and Electric Co.

*Roper, George D. October 27, 1896. October 16, 1901.
Rockford, Ill., Vice-President of the Boone Gas Co., Boone, Iowa.

Rosenquest, Eugene. October 18, 1899.
Cor. Main and 2nd streets, Westchester, New York City, President of the Bronx Gas and Electric Co.

Rosenthal, Albert. October 19, 1898.
1st avenue and 1st street, Mount Vernon, N. Y., Superintendent of the Westchester Lighting Co.

Ross, Alexander. October 27, 1896.
411 North 11th street, St. Louis, Mo., Secretary and General Manager of Laclede Gas Light Co.

Ross, J. Charles. October 19, 1898.
Steubenville, Ohio, Superintendent of The Steubenville Traction and Light Co.

Rossman, G. M. October 19, 1898.
Keene, N. H., Treasurer Keene Gas Light Co.

Rowland, Charles L. October 17, 1888.
102 Greene street, Brooklyn, N. Y., Proprietor of the Morton Iron Works.

Rowland, Thomas F. May 13, 1874.
329 Madison avenue, New York, N. Y., President of the Continental Iron Works, Brooklyn, N. Y.

Rowland, William L. October 20, 1886.
4800 Chester avenue, Philadelphia, Pa., Superintendent of Ammonia Co. of Philadelphia.

Ruggles, C. S. J. October 16, 1901.
Gardner, Mass., Superintendent of the Gardner Gas Co.

Rusby, John M. October 17, 1888.
6th and Provost streets, Jersey City, N. J., Engineer of Hudson County Gas Co.

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* First date is that of election to membership in the Association; second that of transfer from Associate to Active Membership.

Russell, Daniel R. October 19, 1887.
417 Pine street, St. Louis, Mo., Vice-President of the Parker Russell Mining and Manufacturing Co.

Russell, Henry Z. October 17, 1894.
Honesdale, Pa , Secretary and Treasurer of Honesdale Gas Co.

Sabbaton, F. A. October 18, 1899.
Glens Falls, N. Y., Secretary of Glens Falls Gas and Electric Light Co.

Sargent, Fred. H. October 16, 1901.
Lawrence, Mass , Superintendent of the Lawrence Gas Co.

Schniewind, F. October 27, 1896.
Ph.D., 277 Broadway, New York, N. Y., Consulting Chemical Engineer of the United Coke and Gas Co.

Schwarm, C. A. October 17, 1900.
521 Broadway, Lorain, Ohio, General Superintendent of the Gas Department, Lorain Gas Company.

Scrafford, Wm. H. October 19, 1887.
Bath. N. Y., P. O. Box 93, Superintendent of Bath Gas Co.

Searle, Robert M. October 15, 1890.
1st avenue and 1st street, Mount Vernon, N. Y., P. O. Box 245. Engineer Gas Department of the Westchester Lighting Co.

Seaverns, F. October 17, 1883.
228 Produce Exchange Building, New York, N. Y., Treasurer of The Perkins Co.

Secord, W. L. October 16, 1901.
42 Washington avenue, New Rochelle, N. Y., Chief Clerk in charge of distribution of New Rochelle District of the Westchester Lighting Co.

Serrill, William J. October 21, 1891.
Broad and Arch streets, Phlladelphia, Pa., P. O. Box 1564, Engineer of Distribution, The United Gas Improvement Co.

Seymour, William W. October 16, 1901.
Tacoma, Wash., President Tacoma Gas and Electric Light Co.

Shattuck, John D. October 19, 1898.
889 Main street, Darby, Pa., P. O. Box 156, Superintendent of Philadelphia Suburban Gas Co.

Shelton, Frederick H. October 17, 1888.
112 N. Broad street, Philadelphia, Pa., Secretary of various Gas companies.

Sherman, F. C. October 20, 1875.
80 Crown street, New Haven, Conn., P. O. Drawer 107, Superintendent of The New Haven Gas Light Co.

Simpson, Mastin. October 17, 1900.
730 Delaware street, Kansas City, Mo., Confidential Clerk of H. P. Wright & Co.

Sisson, Frank N. October 20, 1886.
139 Lancaster street, Albany, N. Y., Superintendent at Albany of Welsbach Commercial Co.

Slade, Richmond E. October 19, 1892.
Lockport, N. Y., Superintendent Lockport Gas and Electric Light Co.

Slaney, Henry C. October 16, 1889.
466 6th street, Brooklyn, N. Y., Gas Engineer.

Slater, A. B. October 15, 1873.
251 Rhodes street, Providence, R. I., P. O. Box 1260.

Slater, A. B., Jr. October 18, 1888.
209 Equitable Building, Boston, Mass., P. O. Box 3184, Consulting and Constructing Gas Engineer.

Slater, Howard C. October 27, 1896.
209 Equitable Building, Boston, Mass., P. O. Box 3184, Assistant Engineer of A. B. Slater, Jr.

Sloper, Andrew J. October 18, 1899.
19 W. Main street, New Britain, Conn., P. O. Box 778, Treasurer of New Britain Gas Light Co.

Smart, Fred. R., Jr. October 17, 1900.
25 West Market street, York, Pa., General Manager York Gas Company.

Smith, John W. October 20, 1886.
60 Laurel street, Philadelphia, Pa., Superintendent of Northern Liberties Gas Co.

Smith, Robert A. C. October 17, 1883.
100 Broadway, American Surety Building, New York, N. Y.

Smith, William H. October 21, 1891.
1931 South 9th street, Philadelphia, Pa , District Superintendent Department of Distribution United Gas Improvement Co.

Snow, William H. October 19, 1887.
338 Maple street, Holyoke, Mass., P. O. Box 552, Superintendent of Holyoke Gas Works.

Somerville, James. October 20, 1875.
Cor. Penn and Louisiana streets, Indianapolis, Ind , Engineer and Superintendent of Indianapolis Gas Co.

Spangenberg, B. H. October 20, 1897.
Town Hall, Germantown, Philadelphia, Pa., Superintendent Germantown District, The United Gas Improvement Co.

Spaulding, Charles F. October 16. 1878.
Warren avenue, Waltham, Mass., Superintendent of Waltham Gas Light Co.

Spinning, W. V. October 18, 1899.
12 West Third street, Peru, Ind., Lock Box 93, Superintendent Peru American Gas Co.

Spragle, L. D. October 19, 1898.
210 W. Main street, Johnstown, N. Y., P. O. Box 234, Acting Agent of the Fulton County Gas and Electric Co., Johnstown and Gloversville, N. Y.

Sprague, Charles H. October 18, 1882.
70 Kilby street, Boston, Mass., P. O. Box 3105.

Stacey, James E. October 27, 1896.
239 Mill street, Çincinnati, Ohio, President and Manager of The Stacey Manufacturing Co.

Steck, Henry. October 21, 1891.
631 Chestnut street, Philadelphia, Pa., Treasurer of the Town of Hempstead Gas and Electric Light Co.

Stedman, William A. October 17, 1877.
785 Flatbush avenue, Brooklyn, N. Y., Vice-President and General Manager of Flatbush Gas Co.

Stilwell, B. W. October 18, 1899.
67 N. Broadway, Yonkers, N. Y., Secretary of the Westchester Lighting Co.

Stirzel, J. W. October 16, 1895.
Richmond and Tioga streets, Philadelphia, Pa., Superintendent of Station B, United Gas Improvement Co. and Equitable Illuminating Gas Light Co.

Stratton, F. A. October 16, 1901.
Mount Vernon, N. Y., Vice-President of the Westchester Lighting Co.

Strecker, Alexander H. October 20, 1897.
575 Broad street, Newark, N. J., Engineer of the Essex and Hudson Gas Co.

Strong, C. D. October 17, 1900.
168 Broadway, Long Branch, N. J., General Manager Consolidated Gas Company of New Jersey.

Stroud, Morris W. October 16, 1895.
222 South Third street, Philadelphia, Pa., President of the American Gas Co.

Taber, Robert B. October 19, 1881.
Burlington, Vt.

Tait, Frank M. October 17, 1900.
32 Division street, Somerville, N. J., Superintendent of the Somerset Lighting Company.

Taussig, J. Hawley. October 16, 1901.
Newark, N. J., Superintendent of the Market Street Works of the Essex and Hudson Gas Co.

Tayler, George H. October 18, 1882.
209 Main street, Warren, Ohio, Secretary, Treasurer and Superintendent of Warren Gas Light Co.

Taylor, J. D., Jr. October 16, 1901.
Pueblo, Colo., Secretary and General Manager of the Pueblo Gas Light Co.

Terry, F. L. October 18, 1899.
New Britain, Conn., with the Connecticut Railway and Lighting Co.

Thomas, John W. October 19, 1898.
Vallejo, Cal., Superintendent Vallejo Gas Light Co.

Thomas, William C. October 18, 1899.
114 Main street, Hackensack, N. J., Treasurer of the Gas and Electric Co. of Bergen Co.

Thompson, F. De V. October 16, 1901.
Springfield, Mass., General Manager of the Springfield Gas Light Co.

Thompson, Paul. October 17, 1900.
N. W. Corner Broad and Arch streets, Philadelphia, Pa., Assistant General Agent Philadelphia Gas Works, The United Gas Improvement Company.

Thwing, Orrell O. October 16, 1895.
Main and Howard streets, St. Louis, Mo, Superintendent of Station B, Laclede Gas Light Co.

Tippy, B. O. October 16, 1901.
Detroit, Mich., Superintendent of the Detroit City Gas Co.

Tobey, Franklin, Jr. October 19, 1892.
608 Broadway, Kingston, N. Y., P. O. Box 55, Sub Station 2, Superintendent Kingston Electric Co.

Travis, F. M. October 17, 1900.
80 Crown street, New Haven, Conn., Treasurer of the New Haven Gas Light Company.

Tull, Lucien P. F. October 16, 1901.
340 Third avenue, New York, N. Y., Auditor of the New Amsterdam Gas Co.

Turner, Thomas. May 13, 1874.
224 Calhoun street, Charleston, S. C., P. O. Box 6.

Tuthill, J. B. T. October 19, 1898.
4 Chemeketa street, Salem, Oregon, P. O. Box X, Manager Salem Gas Light Co.

Tuttle, William B. October 18, 1899.
Long Branch, N. J., Superintendent of the Consolidated Gas Co. of New Jersey.

Vanderpool, Eugene, October 16, 1873.
757 Broad street, Newark, N. J., Civil and Consulting Engineer.

Voorhis, A. M. October 17, 1894.
Broadway, Nyack, N. Y., P. O. Box 114, President, Treasurer and Manager of Nyack Gas Light and Fuel Co.

Wakeman, E. A. October 19, 1898.
Batavia, N. Y., Superintendent Consolidated Gas and Electric Co.

Walbridge, H. D. October 17, 1894.
109 Ottawa street, Grand Rapids, Mich., President of the Grand Rapids Gas Light Co.

Waldo, Charles S. October 20, 1886.
102 Milk Street, Boston, Mass., P. O. Box 3436, Waldo Bros., Gas Retorts and General Supplies.

Wales, Harry B. October 19, 1898.
109 Ottawa street, Grand Rapids, Mich., Treasurer Grand Rapids Gas Light Co.

Walker, Edwin M. October 18, 1899.
34 Fairmount avenue, Hyde Park, Mass., Superintendent and Secretary of Dedham and Hyde Park Gas and Electric Light Co.

Walker, M. Timmons. October 17, 1900.
207 Pine street, Fort Madison, Iowa, P. O. Box 202, General Manager Fort Madison Gas Light Co.

Walker, Sidney R. October 16, 1901.
401 Center street, Bay City, Mich., Superintendent of the Bay City Gas Co.

Walters, Anderson H. October 21, 1891.
405 Main street, Johnstown, Pa., Secretary and Superintendent of Consumers' Gas Co.

Walters, Benj. S. October 17, 1900.
2051 Walnut street, Philadelphia, Pa., Constructing Engineer High Pressure Gas Installations.

Ward, William H. October 19, 1892.
228 Front street, Easton, Pa.

Waring, Geo. H., Jr. October 16, 1901.
Savannah, Ga., Superintendent of the Mutual Gas Light Co.

Warmington, Daniel R. October 21, 1891.
410 Pearl street, Cleveland, Ohio, General Manager of the People's Gas Light Co.

Warmington, George H. May 13, 1874.
410 Pearl street, Cleveland, Ohio, President of the People's Gas Light Co.

Warner, George H. October 18, 1899.
1131 Broadway, New York, N. Y., Vice-President of Peekskill Gas Light Co.

Weber, Adam. October 13, 1880.
633 East 15th street, New York, N. Y., Proprietor of Manhattan Fire Brick and Enamel Clay Retort Works.

Weber, Oscar B. October 17, 1883.
633 East 15th street, New York, N. Y., President of Adam Weber Sons, Weber, N. J.

Wehner, Adolph F. October 17, 1894.
245 Broadway, New York, N. Y., Secretary Isbell-Porter Co.

Wells, L. W. October 19, 1898.
137 East 5th street, Canton, Ohio, Superintendent Canton Gas Light and Coke Co.

Westcott, John T. October 18, 1893.
19 Abingdon street, Westminster, London, S. W., Eng., General Manager of the Economical Gas Apparatus Construction Co.; also 269 Front street East, Toronto, Canada.

Wharton, W. S. October 17, 1900.
301 Holly street, Whatcom, Wash., General Manager Bellingham Bay Gas Company, Whatcom and Fairhaven, Wash.

Wheeler, Fred. B. October 18, 1893.
30 Chenango street, Binghamton, N. Y., P. O. Box 653, General Manager Binghamton Gas Works.

Whipple, Henry S. October 19, 1898.
201 Mulberry street, Rockford, Ill., Superintendent Rockford Gas Light and Coke Co.

Whitcomb, Henry D., Jr. October 18, 1899.
Newark, N. J., care of Essex and Hudson Gas Co.

White, Chas. E. October 18, 1899.
210 Main street, Wakefield, Mass., Manager of Wakefield Municipal Light Plant.

White, Edward D. October 17, 1883.
88 Van Dyke street, Brooklyn, N. Y., Director of Brooklyn Fire Brick Works.

White, Henry H. October 21, 1891.
Portsmouth, Va., P. O. Box 39, Superintendent of Portsmouth Gas Co.

White, Wm. Henry. April 16, 1873.
32 Pine street, New York, N. Y., Engineer and Contractor.

Whitney, Henry C. October 21, 1891.
Arsenal street, Watertown, N. Y., President and Manager of Watertown Gas Light Co.

Whittaker, Alan Dean. October 19, 1898.
146 Ellison street, Paterson, N. J., Assistant Superintendent The Paterson and Passaic Gas and Electric Co.

Whittier, Charles R. October 19, 1887.
45 Broadway, New York, N. Y., care of C. W. Hunt Co.

Wilcox, John F. October 27, 1896.
1310 New England Building, Cleveland, Ohio, General Manager and Chief Engineer of The Retort Coke Oven Co.

Williams, E. H. October 17, 1888.
150 Grand street, Waterbury, Conn., P. O. Box 223, Agent and Superintendent of The United Gas Improvement Co.

Williams, Herbert G. October 16, 1901.
37 South 13th avenue, Mount Vernon, N. Y., Agent Westchester Lighting Co.

Williams, L. S. October 19, 1898.
1204 North 2nd street, Harrisburg, Pa., Superintendent The United Gas Improvement Co.

Williams, W. L. October 15, 1890.
183 Tyler street, Paterson, N. J., Superintendent of the Gas Department of The Paterson and Passaic Gas and Electric Co.

Williamson, John. October 18, 1893.
157 Michigan avenue, Chicago, Ill., Consulting Engineer of The People's Gas Light and Coke Co.

Wilson, H. B. October 18, 1899.
40 Wall street, New York, N. Y., President of Lockport Gas and Electric Co.

Witherby, Edwin E. October 19, 1898.
40 Wall street, New York, N. Y., General Manager Union Gas and Electric Co.

Wood, Austin C. April 16, 1873.
216 North West street, Syracuse, N. Y.

*Wood, Stuart. October 18, 1899. October 17, 1900.
400 Chestnut street, Philadelphia, Pa., Treasurer of the Macon Gas Light and Water Company.

Wood, I. B. October 16, 1901.
6th and Provost streets, Jersey City, N. J., Superintendent of the Jersey City Works of the Hudson County Gas Co.

Wood, Walter. October 19, 1881.
400 Chestnut street, Philadelphia, Pa., Manager of Millville Gas Light Co.

Wood, William A. October 16, 1889.
24 West street, Boston, Mass., Assistant Engineer of Boston Gas Light Co.

Woods, George E. October 20, 1897.
4 Irving Place, New York City, Engineer of Manufacture of The Consolidated Gas Co.

Woodward, Ralph. October 19, 1898.
Pittsfield, Mass., General Manager of Pittsfield Coal Gas Co.

Wortendyke, Ira F. October 27, 1896.
Janesville, Wis., Superintendent of New Gas Light Co.

Yorke, Eugene H. October 19, 1881.
40 West Commercial street, Portland, Me., Engineer of Portland Gas Co.

Young, James M. H. October 20, 1897.
Joplin, Mo., Superintendent Joplin Gas Co.

Young, John. October 18, 1882.
603 West Diamond street, Allegheny, Pa., Superintendent of the Allegheny Heating Co., and Allegheny Illuminating Co.

Young, Percy S. October 18, 1899.
Montgomery street, Jersey City, N. J., P. O. Box R. Assistant Secretary and Treasurer of the Hudson County Gas Co.

Young, Peter. October 21, 1885.
210 Wayne County Bank Building, Detroit, Mich., Engineer Baxter & Young.

Young, Richard R. October 16, 1901.
185 Main street, Passaic, N. J., Agent for the Passaic District of The Paterson and Passaic Gas and Electric Co.

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Young, Robert. October 20, 1875.
435 Sixth avenue, Pittsburg, Pa., General Manager Consolidated Gas Co. of City of Pittsburg.

Young, Robert, Jr. October 16, 1901.
327 Spring street, Atlanta, Ga., Superintendent of the Atlanta Gas Light Co.

Zeek, Charles F. October 15, 1890.
3 South Palafox street, Pensacola, Fla., Superintendent of Pensacola Gas Co.

Zollikoffer, Oscar F. October 19, 1892.
49 West 54th street, New York, N. Y.

ASSOCIATE MEMBERS.

Alcott, Franklyn L. October 19, 1898.
Cleveland, Ohio, General Manager and Secretary of The Standard Lighting Co.

Allen, Walter S. October 19, 1892.
New Bedford, Mass.

Atwater, Christopher G. October 19, 1898.
277 Broadway, New York, N. Y., with The United Coke and Gas Co., House Address, 243 West 98th street, New York, N. Y.

Backus, Q. S. October 19, 1894.
Williamsport, Pa., President and General Manager of Backus Manufacturing Co.

Baldwin, Chas. H. October 16, 1901.
159 Franklin street, Boston, Mass., P. O. Box 2410, Manager of the National Meter Company, Manufacturers of Gas Engines and Water Meters.

Barbour, W. T. October 18, 1899.
Detroit, Mich., President of Detroit Stove Works.

Barrows, George Shattuck. October 16, 1901.
Gloucester City, N. J., Engineer of the Welsbach Light Co.

Bartlett, D. Lewis. October 19, 1898.
General Manager of Bartlett, Hayward & Co., Baltimore, Md., Manufacturers of Gas Works Apparatus.

Bassett, Frank A. October 16, 1901.
Bridgeport, Conn., P. O. Box 12, Sales Agent of Righter and Marshall.

Bayles, James C. October 19, 1898.
M. E., Ph.D., 14 Cortlandt street, New York, N. Y., Chief Engineer Bayles Engineering Co.

Behrend, Fritz. October 17, 1894.
54 Front street, New York, N. Y., Clay Gas Retort Importer.

Bernstein, S. October 16, 1901.
82 West Broadway, New York, N. Y., President of the S. Bernstein Co.

Boal, Stanhope. October 18, 1899.
Piqua, Ohio, Vice-President of Favorite Stove and Range Company, Manufacturers of Gas Ranges.

Bower, William H. October 17, 1900.
Gray's Ferry Road and 29th street, Philadelphia, Pa., General Manager of the Chemical Works of the Ammonia Company of Philadelphia.

Brown, Frank H. October 19, 1892.
Waltham, Mass., Treasurer and Superintendent of Davis & Farnum Manufacturing Co.

Burchard, Lewis Sayre. October 16, 1901.
6 Wall street, New York, N. Y., President and Treasurer of the Webber Prepayment Attachment Co.

Buss, Julius. October 19, 1892.
Milwaukee, Wis., P. O. Box 232, Engineer with Fred. Bredel, Gas Engineer and Contractor.

Carpenter, H. A. October 20, 1897.
Allegheny, Pa., Engineer with Riter-Conley Mfg. Co.

Cartwright, Henry R. October 18, 1899.
N. W. cor. 22nd and Arch streets, Philadelphia, Pa., Manager American Meter Company (Philadelphia factory).

Casey, Wm. J. October 17, 1900.
San Francisco, Cal., President of the Union Gas Engine Company.

Chaney, Franklin V. October 16, 1901.
28 Oliver street, Boston, Mass., Publisher of Gas Literature, Home Science Publishing Co.

Coburn, Cyrus M. October 19, 1892.
Chelsea, Mass., Agent and Manager of Liberty Oil Co., House Address, 61 Shurtleff street.

Coleman, H. W. October 19, 1898.
1051 and 1053 Drexel Building, Philadelphia, Pa., Eastern Agent Stacey Manufacturing Co.

Crane, William M. October 16, 1889.
1131 Broadway, New York, N. Y., President Wm. M. Crane Co., Gas Stoves, etc.

Curley, Edward J. October 18, 1893.
827 Market street, Wilmington, Del., Assistant Superintendent of Wilmington Coal Gas Co.

DeHart, J. S., Jr. October 19, 1898.
46 Bridge street, Newark, N. J., Engineer with Isbell-Porter Co.

Dickel, Wm. L. October 16, 1901.
Somerville, N. J , President of the Boulevard Globe and Lamp Co.

Dickey, Edmund S. October 17, 1900.
Baltimore, Md., P. O. Box 773, with The Maryland Meter and Manufacturing Company.

Dods, John C. October 16, 1901.
915 Wainwright Building, St. Louis, Mo., Engineer with the Laclede Fire Brick Manufacturing Co.

Dougherty, H. N. October 27, 1896.
95 Liberty street, New York, N. Y., Vice-President of M. H. Treadwell & Co.

Drummond, M. J. October 20, 1897.
192 Broadway, New York, N. Y., Manufacturer of Cast Iron Pipe.

Duck, George F. October 19, 1898.
Pittsburg, Pa., P. O. Box 334.

Eaton, Alfred B. October 27, 1896.
70 Wabash avenue, Welsbach Building, Chicago, Ill., Western Sales Agent of the United Gas Improvement Co.

Fisk, John T. October 18, 1899.
Concord, N. H., Gas Stove Salesman with Schneider & Trenkamp Co. of Cleveland, Ohio.

Floyd, James R., Jr. October 19, 1898.
Catasauqua, Pa., Secretary Union Foundry and Machine Co.

Graves, George W. October 20, 1897.
32 South avenue, Rochester, N. Y., Salesman with Abendroth Bros.

Gribbel, Wm. S. October 18, 1899
52 Dey street, New York, N. Y., Agent of John J. Griffin & Company.

Guenther, Carl M. October 18, 1899.
12th and Brown streets, Philadelphia, Pa., Manager of Harris Bros. & Company.

Harper, H. D. October 17, 1900.
34 W. Monroe street, Chicago, Ill., Chicago Agent of D. McDonald & Co.

Hartenfels, P. October 20, 1897.
120 Liberty street, New York, N. Y., Manufacturer of Patent Gas Leak Indicator and Supplies.

Hayward, Sterling F. October 15, 1890.
395 Broadway, New York, N. Y., Treasurer and General Manager of Connelly Iron Sponge and Governor Co.

Henderson, E. H. October 27, 1896.
355 Fifth avenue, Pittsburg, Pa., P. O. Box 373, President of James Gardner, Jr. Co.

Higgins, C. M. October 21, 1891.
26 Broadway, New York, N. Y., with Standard Oil Co.

Hinman, Charles W. October 27, 1896.
8 Medford street, Boston, Mass., with Nathaniel Tufts Meter Co.

Hunter, Harry W. October 16, 1901.
851 Equitable Building, Baltimore, Md., Salesman of F. & L. Kahn & Bros., Hamilton, Ohio.

Jacobs, Charles H. October 20, 1897.
3rd and Leonard streets, Detroit, Mich., Secretary, Treasurer and General Superintendent of Detroit Meter Co.

Johnston, E. D. October 17, 1900.
Connersville, Ind , President and General Manager of P. H. & F. M. Roots Company.

Latta, M. Nisbet. October 17, 1900.
Charlotte, N. C., Engineer Charlotte Railway, Light and Power Company.

Leakey, Nathan G. October 16, 1901.
Detroit, Mich., Assistant Secretary and Treasurer of the Michigan Ammonia Works.

Lippincott, Wilbur M. October 16, 1901.
212 West 114th street, New York, N. Y., Salesman of The American Incandescent Gas Co.

Little, George B. October 19, 1892.
103 State street, Boston, Mass., of Stratton, Little & Co., Coal Dealers.

Luqueer, Robert O. October 18, 1899.
M. E., 31 Nassau street, New York, N. Y., Assistant Engineer of Humphreys & Glasgow.

McDonald, Donald. October 21, 1891.
51 Lancaster street, Albany, N. Y., Superintendent of D. McDonald & Co., Gas Meter Manufacturers.

McIlravy, W. N. October 16, 1901.
100 William street, New York, N. Y., Agent of the National Coal Tar Co.

McIntire, John K. October 18, 1899.
116 No. Main street, Dayton, Ohio, Director of Dayton Gas Light and Coke Company.

Marsh, Converse D. October 16, 1901.
136 Liberty street, New York, N. Y., President of Bryan-Marsh Co., Manufacturer of Photometers.

Mills, Wm. A. October 16, 1901.
Portchester, N. Y., Secretary of Abendroth Brothers.

Mordue, Thomas N. October 16, 1895.
Old Colony Building, Chicago, Ill., Agent Castner, Curran & Bullitt.

Mueller, Robert. October 17, 1900.
230 North Main street, Decatur, Ill., Manager and Assistant Secretary and Treasurer of H. Mueller Manufacturing Co.

Nichols, Carroll B. October 16, 1901.
224 South 3rd street, Philadelphia, Pa., Salesman of The Westmoreland Coal Co.

Nicolls, J. O. October 27, 1896.
Real Estate Trust Building, Philadelphia, Pa., General Sales-Agent Vinton Colliery Co.

Norton, Arthur E. October 18, 1899.
8 Medford street, Boston, Mass., Representing Nathaniel Tufts Meter Co.

Norton, Harry A. October 17, 1888.
8 Medford street, Boston, Mass., Manager Nathaniel Tufts Meter Co.

Osborne, Willard B. October 19, 1898.
Allegheny, Pa., Constructing Engineer Riter-Conley Co.

Osius, George. October 16, 1889.
Detroit, Mich., Secretary and Treasurer of Michigan Ammonia Works.

Page, Albion L. October 21, 1891.
180 Fulton street, New York, N. Y., of Geo. Shepard Page's Sons.

Palmer, George Q. October 16, 1901.
742 East 12th street, New York, N. Y, Manager of the Quintard Iron Works.

Payne, F. H. October 17, 1900.
Erie, Pa., Manager of The Metric Metal Works.

Pearson, Joshua Ash. October 20, 1897.
Broad and Arch streets, Philadelphia, Pa., P. O. Box 1564, Purchasing Agent The United Gas Improvement Co.

Persons, Fred. R. October 17, 1888.
317 St. Clair street, Toledo, Ohio, Representative of Maryland Meter and Mfg. Co. of Baltimore.

Platt, E. S. October 27, 1896.
Room 218, Commercial Building, St. Louis, Mo., Secretary and Treasurer of George Platt & Co.

Prendergast, Daniel J. October 20, 1897.
33 Nassau street, New York, N. Y., General Superintendent Welsbach Street Lighting Company of America.

Roberts, Clarence V. October 16, 1901.
3rd and Mifflin streets, Philadelphia, Pa., Vice-President of the Thomas, Roberts, Stevenson Co.

Rodgers, E. H. October 16, 1901.
942–944 Drexel Building, Philadelphia, Pa., Treasurer of the Standard Meter Company.

Sadtler, J. P. B. October 18, 1899.
813 S. Howard street, Baltimore, Md., of J. P. B. Sadtler & Co.

Scheel, Henry C. October 18, 1893.
11 Broadway, Bowling Green Offices, New York, N.Y., Wholesale Coal Dealer.

Silliman, Alfred D. October 18, 1899.
Broad and Arch streets, Philadelphia, Pa., Cadet Engineer of The United Gas Improvement Co.

Slocum, Frank L. October 19, 1892.
Conestoga Building, Pittsburg, Pa., President of the Gas Engineering Co.

Steward, Robert Bruce. October 18, 1899.
Chattanooga, Tenn., Vice-President of D. M. Steward Manufacturing Co.

Stratton, S. S. October 16, 1889.
88–92 West Jackson Boulevard, Chicago, Ill., Agent Maryland Meter Co.

Stroh, George. October 16, 1901.
Detroit, Mich., Superintendent of the Michigan Ammonia Works.

Summey, D. L. October 19, 1898.
N. W. cor. Broad and Arch streets, Philadelphia, Pa., Engineer with The United Gas Improvement Co.

Taylor, Horace G. October 18, 1899.
M. E., 38 Victoria street, London, S. W., England, Assistant Engineer of Humphreys & Glasgow.

Terhune, Chas. F. October 16, 1901.
1133 Broadway, New York, N. Y., Vice-President of Wm. M. Crane Co.

Tolman, Wm. Nichols. October 17, 1900.
3067 E. Thompson street, Philadelphia, Pa., Master Mechanic Station B, Philadelphia Gas Works of The United Gas Improvement Company.

Trenkamp, H. J. October 19, 1898.
Cleveland, Ohio, Secretary the Schneider & Trenkamp Co.

Van Wie, E. G. October 27, 1896.
1320 Jefferson avenue, Detroit, Mich., Manager Gas Appliance Department, Detroit Stove Works.

Webber, Wesley. October 16, 1901.
6 Wall street, New York, N. Y., Engineer of the Webber Prepayment Attachment Company.

Wehner, R. K. October 17, 1898.
46 Bridge street, Newark, N. J., Assistant Treasurer of Isbell-Porter Co.

Welch, John S. October 16, 1901.
N. W. cor. Broad and Arch streets, Philadelphia, Pa., Gas Engine Expert with The United Gas Improvement Co.

Wells, Fred. K. October 27, 1896.
356 Fourth avenue, New York, N. Y., Manager Eastern Office, George M. Clark & Co. of Chicago.

Wharton, Henry. October 16, 1895.
224 South 3rd street, Philadelphia, Pa., P. O. Box 1322, Assistant Secretary Westmoreland Coal Co.

Wickham, Leigh. October 16, 1901.
St. Louis, Mo., Salesman of the Parker-Russell Mining and Manufacturing Co.

Wilbraham, John S. October 19, 1892.
2518 Frankford avenue, Philadelphia, Pa., Secretary and Treasurer of Wilbraham-Baker Blower Co.

Wilbraham, John W. October 19, 1892.
2518 Frankford avenue, Philadelphia Pa., President of Wilbraham-Baker Blower Co.

Wilkinson, C. T. October 16, 1901.
Brockville, Ontario, Canada, Consulting Gas and Electric Engineer.

Wood, Edward R., Jr. October 17, 1900.
245 South 17th street, Philadelphia, Pa., with R. D. Wood & Co.

Honorary Members	12
Active Members	499
Associate Members	97
Total	608

MEMBERS OF THE AMERICAN GAS LIGHT ASSOCIATION, ARRANGED GEOGRAPHICALLY.

ALABAMA.

Birmingham	J. T. B. Cocke.	

ARKANSAS.

Pine Bluff	L. I. Pollitt.	

CALIFORNIA.

Los Angeles	W. B. Cline	457 South Broadway
Napa	T. R. Parker.	
Oakland	John A. Britton.	
Pasadena	T. S. C. Lowe.	
Salinas	John Clements	134 Central avenue
San Francisco	Wm. J. Casey.	
	Joseph B. Crockett	415 Post street
	Walter S. Dole	321 Market street
	Frederick H. Eichbaum	101 Devisadero street
	Edward C. Jones	415 Post street
	C. O. G. Miller	455 Sutter street
Vallejo	John W. Thomas.	

COLORADO.

Colorado Springs	Ira Abbott Miller	104 N. Tejon street
	William C. Paullins	104 N. Tejon street
Denver	William A. Baehr	405 17th street
	A. H. Branch	637 16th avenue
	Irvin Butterworth	405 17th street
	Philip Cross	405 17th street
	Frank W. Frueauff	405 17th street
	John H. Poole	405 17th street
Pueblo	J. D. Taylor, Jr.	

CONNECTICUT.

Bridgeport	Frank A. Bassett.	
	William R. Higby	380 Main street
Danbury	Charles H. Merritt	350 Main street
Derby	Charles H Nettleton.	
Hartford	John P. Harbison.	
	John W. Hatstat.	
	Burdett Loomis.	
Meriden	Charles A. Learned	40 Colony street
New Britain	Everett C. Learned	118 Maple street
	Andrew J. Sloper	19 West Main street
	F. L Terry.	
New Haven	F. C. Sherman	80 Crown street
	F. M. Travis	80 Crown street
New London	A. G. B. Hunt.	
Norwalk	L. C. Hanford	1 Belden avenue
Stamford	Walter M. Jackson	9 Oliver street
Waterbury	E. H. Williams	150 Grand street
Winsted	Rufus E. Holmes	55 High street

DELAWARE.

Wilmington	Edward Betts	827 Market street
	George S. Capelle	827 Market street
	Edward J. Curley	827 Market street
	Thomas Curley	827 Market street

DISTRICT OF COLUMBIA.

Washington	C. Clay Bayly.	
	Thos. F. Holden	12th and M streets, S. E.
	John Leetch	1409 31st street
	James S. McIlhenny	26th and G streets, N.W.
	John R. McLean	413 10th street, N.W.
	Robert L. Middleton	1411 30th street, N.W.

FLORIDA.

Jacksonville	Clarence S. Hammatt	26 Main street
Pensacola	Charles F. Zeek	3 South Palafox street
St. Augustine	George Old.	
Tampa	A. J. Boardman	Roberts Building

GEORGIA.

Atlanta	W. L. Cosgrove	Alabama and Broad streets
	Robert Young, Jr.	327 Spring street
Columbus	James Ferrier	1149 Broad street
Savannah	John W. Golden.	
	George H. Waring, Jr.	

TERRITORY OF HAWAII.

Honolulu	Alonzo Gartley	King and Alekea streets

ILLINOIS.

Alton	J. F. Porter	205 Market street
Cairo	John W. Eakin	709 Ohio Levee street
Chicago	W. I. Battin	25th and Loomis streets
	A. B. Eaton	70 Wabash avenue
	Chas. H. Evans	300 53rd street
	A. R. Foote	132 Market street
	H. D. Harper	34 W. Monroe street
	Carroll Miller	The Rookery
	Thomas N. Mordue	Old Colony Building
	T. V. Purcell.	
	S. S. Stratton	88-92 W. Jackson Boulevard
	John Williamson	157 Michigan avenue
Decatur	Robert Mueller	239 N. Main street
Elgin	Carl H. Dunbar	167 Du Page street
	Robert F. Fitz	361 Douglas avenue
Evanston	Rufus C. Dawes	1611 Benson avenue
Galesburg	Charles L. Gerould.	
Oak Park	Edward E. Morrell	221 Wesley avenue
Peoria	F. W. Little	125 North Jefferson avenue
Rockford	George D. Roper.	
	Henry S. Whipple	201 Mulberry street
Waukegan	Geo. F. Goodnow.	

INDIANA.

Connersville	E. D. Johnston.	
Evansville	Edward J. Elles.	

Fort Wayne......Alfred D Cressler....Calhone and Murray sts.
Olaf N. Guldzin.......157 West Berry street
G. Max Hofmann.
C. S. Knight....Oliver and Buchanan streets
Indianapolis......James Somerville..Cor. Penn & Louisiana sts.
Michigan City....Walter M. Blinks.
New Albany......James W. Dunbar..Sycamore and 7th streets
Peru..............W. V. Spinning............12 West 3rd street
Terre Haute......M. N. Diall.................507 Ohio street

IOWA.

Burlington........ Edward D. Clary...... 914 North 6th street
Clinton...........S. M. Highlands.
Des Moines.......Edward G. Pratt..........413 Locust street
Dubuque.........George McLean............669 Main street
Fort Madison.....M. Timmons Walker.........207 Pine street
Oskaloosa........William Bailey......216 High avenue, West
Ottumwa.........H. B. Maynard.
Sioux City........L. L. Kellogg.

KANSAS.

Fort Scott........William H. Frost........11 East Wall street
Kansas City......Northrop Moore...........Husted Building

KENTUCKY.

Hopkinsville......Thomas G. Littlehales.
Louisville........A. H. Barret.........Sixth and Green streets

MAINE.

Bangor.......... Charles E. Dole.
Portland..........Eugene H. Yorke....4 W. Commercial street

MARYLAND.

Baltimore.........Edward L. Bartlett..McHenry and Scott sts.
D. Lewis Bartlett.
George Beadenkopf..........19 South street
Charles H. Dickey..North and Saratoga sts.
Edmund S. Dickey.

Baltimore	Francis H. Hambleton	19 South street
	Thomas J. Hayward	McHenry and Scott sts.
	Harry W. Hunter	851 Equitable Building
	Frederick J. Mayer	McHenry and Scott sts.
	J. P. B. Sadtler	813 South Howard street

MASSACHUSETTS.

Boston	Walter R. Addicks	24 West street
	Forrest E. Barker	State House, Room 145
	Chas. H. Baldwin	159 Franklin street
	Albert C. Burrage	24 West street
	Chas. D. Burrage	24 West street
	Franklin V. Chaney	28 Oliver street
	Arthur E. Childs	23 Central street
	Fred. J. Davis	74 Montgomery street
	Samuel J. Fowler.	
	John A. Gould	24 West street
	William H. Hill	40 Water street
	C. W. Hinman	8 Medford street
	John T. Langford	70 Kilby street
	George B. Little	103 State street
	Arthur E. Norton	8 Medford street
	Harry A. Norton	8 Medford street
	A. B. Slater, Jr	209 Equitable Building
	Howard C. Slater	209 Equitable Building
	Charles H. Sprague	70 Kilby street
	Charles S. Waldo	102 Milk street
	William A. Wood	609 Commercial street
Charlestown	Patrick Coyle	27 Arlington avenue
Chelsea	Cyrus M. Coburn	152 Congress avenue
	George W. Moses.	
Chicopee	Chas. H. Nutting	8 Springfield street
Dorchester	William E. McKay	10 Pearl street
East Cambridge	Horace A. Allyn	Third street
Everett	August F. Hilleke.	
Fall River	Chas. F. Leonard.	
	Joseph E. Nute	14 Bedford street
Fitchburg	H. F. Coggshall	376 Main street
Gardner	C. S. J. Ruggles.	

Gloucester	John A. Coffin	Duncan street
Holyoke	William H. Snow	338 Maple street
Hyde Park	Edwin M. Walker	34 Fairmount avenue
Jamaica Plain	Eugene N. Foss	8 Everett street
Lawrence	C. J. R. Humphreys	370 Essex street
	Fred. H. Sargent	42 Washington avenue
Lowell	Geo. S. Motley	
Lynn	Charles F. Prichard	90 Exchange street
Marlboro	G. F. Macmun.	
Medford	Frank E. Chandler.	
New Bedford	Walter S. Allen.	
	Nathaniel W. Gifford.	
Newton	Waldo A. Learned	2 Jewett street
North Adams	Frank S. Richardson	71 Main street
Northampton	H. C. Crafts	216 Main street
Pittsfield	Ralph Woodward.	
Spencer	Thos. H. Clark.	
Springfield	F. de V. Thompson.	
Taunton	Henry B. Leach	68 Washington street
Wakefield	Charles E. White	210 Main street
Waltham	Frank H. Brown.	
	Charles F. Spaulding	Warren avenue
Worcester	Charles D. Lamson	240 Main street
	James J. Humphreys, Jr.	

MICHIGAN.

Adrian	Charles H. Raynor	9 North Winter street
Ann Arbor	Henry W. Douglas	211 Huron street
Bay City	Robert Calhoun	401 Centre avenue
	Sidney R. Walker	401 Centre street
Detroit	W. T. Barbour.	
	Isaac C. Baxter.	
	Paul Doty	230 Woodward avenue
	Charles H. Jacobs	3rd and Learned streets
	Nathan G. Leakey.	
	Eugene T. Lynch.	
	James T. Lynn	301 Wayne Bank Building
	George Osius	Foot Beaufait avenue
	Frank Kerr Pelton	301 Wayne Co. Bank Bldg.

Detroit	Geo. Stroh.	
	B. O. Tippy.	
	E. G. Van Wie	1320 Jefferson avenue
	Peter Young	210 Wayne Bank Building
Grand Rapids	H. D. Walbridge	109 Ottawa street
	Harry B. Wales	109 Ottawa street
Jackson	W. M. Eaton	260 East Main street
Kalamazoo	J. J. Knight.	
Pontiac	William H. Morgans	11 South Saginaw street

MINNESOTA.

St. Paul	A. P. Lathrop, N. W. cor. 6th and Jackson sts.	

MISSOURI.

Joplin	Jas. M. H. Young	
Kansas City	George S. Clarke	10th and Walnut streets
	Mastin Simpson	130 Delaware street
St. Joseph	Kerr M. Mitchell	516 Francis street
St. Louis	Ernest William Bell	716 Locust street
	Byron E. Chollar	714 Locust street
	John Dell	411 Oliver street
	John C. Dods	915 Wainwright Building
	James Green	915 Wainwright Building
	E. S. Platt	218 Commercial Building
	Alexander Ross	411 North 11th street
	Daniel R. Russell	417 Pine street
	Orrell O. Thwing	Main and Howard streets
	Leigh Wickham.	

NEBRASKA.

Lincoln	Edgar J. Powers.	
Omaha	Isaac Battin	1224 Farnam street
	G. W. Clabaugh.	
	John B. Klumpp	20th street and Lincoln ave
	Isaac N. Knapp	1125 South 28th street

NEW HAMPSHIRE.

Concord	John T. Fisk.	
	H. K. Morrison	5 Capitol street

Keene	G. M. Rossman.	
Manchester	Walter G. Africa	39 Hanover street
Nashua	Walter F. Norton	9 Courtland street

NEW JERSEY.

Camden	Benjamin F. Archer	319 Cooper street
Gloucester City	Geo. Shattuck Barrows.	
Hackensack	Carl H. Graf	114 Main street
	Frank B. Poor	185 Main street
	William C. Thomas	114 Main street
Hoboken	Henry Morton	River and 6th streets
	F. N. Morton	Clinton avenue and 13th street
Jersey City	West Bissell	Fuller Building
	David R. Daly	Green and Essex streets
	Dudley D. Flemming	249 Washington street
	John M. Rusby	6th and Provost streets
	T. B. Wood	6th and Provost streets
	Percy S. Young	1 Montgomery street
Keyport	H. W. Davies	
Long Branch	C. D. Strong	168 Broadway
	William B. Tuttle	168 Broadway
Montclair	A. E. Forstall.	
Newark	William H. Allen	575 Broad street
	J. S. DeHart, Jr.	46 Bridge street
	J. P. Dusenberry.	
	C. C. Hartpence	242 Sixth avenue
	Alexander H. Strecker	575 Broad street
	J. Hawley Taussig.	
	Eugene Vanderpool	757 Broad street
	R. K. Wehner	46 Bridge street
	H. D. Whitcomb, Jr.	
Passaic	Richard R. Young.	
Paterson	W. H. Rogers	146 Ellison street
	Alan Dean Whittaker	146 Ellison street
	W. L. Williams	183 Tyler street
Phillipsburg	W. O. Brown.	
Princeton	James E. Burke.	
Somerville	Wm. L. Dickel.	
	Frank M. Tait.	
Trenton	Frank D. Moses	222 East State street

NEW YORK.

Albany	Frank S. Dunn	1131 Broadway
	Donald McDonald	51 Lancaster street
	William McDonald	51 Lancaster street
	Frank N. Sisson	139 Lancaster street
Amsterdam	William H. Cooper.	
Auburn	Willard E. Case.	
	C. D. Robison.	
Batavia	E. A. Wakeman.	
Bath	William H. Scrafford.	
Binghamton	Geo. H. Dawson	285 Court street
	Robert W. Manier	30 Chenango street
	Fred. B. Wheeler	30 Chenango street
Brooklyn	Fred. S. Benson	Kent avenue and Cross st.
	Robert W. Bush, 12th st. and Gowanus Canal	
	Thomas E. Byrne	1st avenue and 55th street
	Charles H. Corbett	428 Lafayette avenue
	James H. Jourdan, Nevins and Degraw streets	
	John D. Logan.	
	William J. Logan.	
	Edwin Ludlam	180 Remsen street
	Charles L. Rowland	102 Green street
	Henry C. Slaney	466 6th street
	William A. Stedman	785 Flatbush avenue
	Edward D. White	88 Van Dyke street
Buffalo	John J. Clahan	133 Whitney place
	J. T. Herron	186 Main street
	Richard M. Parker	186 Main street
	William S. Riselay	188 Main street
Corning	Frank D. Kingsbury	8 East Market street
Elmira	S. N. Blake	501 Realty Building
Far Rockaway, L. I.,	Elmer B. Knight.	
Glens Falls	F. A. Sabbaton.	
Ilion, Herkimer Co.	John A. Giblin	10 East Main street
	J. W. Planck	3 First street
	Thomas Ringwood	4 Armory street
Johnstown	L. D. Spragle	210 W. Main street
Kingston	Franklin Tobey, Jr	608 Broadway
Little Falls	Henry P. Collins.	

Lockport	R. E. Slade.	
Long Island City	W. F. Lawrence.	
Middletown	William J. Max	153 Wickham avenue
Mt. Vernon	Albert Rosenthal	First avenue and 1st street
	Robert M. Searle	First avenue and 1st street
	F. A. Stratton.	
	Herbert G. Williams	37 South 13th avenue
Newburg	Thaddeus R. Beal.	
	Benjamin J. McDonald	296 Grand street
New Rochelle	W. L. Secord	42 Washington avenue
New York	Frederick P. Addicks	52 Broadway
	William A. Armington	256 W. 23rd street
	C. G. Atwater	277 Broadway
	J. C. Bayles, M.E., Ph.D.,	14 Cortlandt street
	William R. Beal	350 Alexander avenue
	Fritz Behrend	54 Front street
	S. Bernstein	82 W. Broadway
	Fred. L. Bradley	99th st. and 2nd avenue
	William H. Bradley	4 Irving place
	Ernest C. Brown	280 Broadway
	Lewis Sayre Burchard	6 Wall street
	John S. Bush.	
	John Cabot	553 West 33rd street
	E. P. Callender	32 Pine street
	William Carpender	32 Pine street
	C. F. Chandler	51 East 54th street
	Alfred S. Cooke	40 Wall street
	William M. Crane	1131 Broadway
	J. Alfred Dixon	160 Broadway
	Robert M. Dixon	160 Broadway
	Henry L. Doherty	40 Wall street
	H. N. Dougherty	95 Liberty street
	W. F. Douthirt	40 Wall street
	M. J. Drummond	192 Broadway
	George B. Edwards	113 Chambers street
	A. B. Eilbeck	40 Wall street
	Wm. L. Elkins, Jr	36 Wall street
	Frederick W. Floyd	742 East 12th street
	Malcolm Montrose Graham,	340 Third avenue
	William S. Gribbel	52 Dey street

New York	Arthur H. Hall	350 Alexander avenue
	Douglass Hamilton	1815 Webster avenue
	P. Hartenfels	120 Liberty street
	Charles D. Hauk	860 St. Nicholas avenue
	Sterling F. Hayward	395 Broadway
	Richard S. Hicks	73 Warren street
	C. M. Higgins	26 Broadway
	David L. Hough	13 21 Park Row
	Alexander C. Humphreys	31 Nassau street
	Ford Huntington	340 Third avenue
	Charles W. Isbell	245 Broadway
	Edward R. Jourdan	4 Irving Place
	James S. Kennedy	115th st. and East River
	Wilbur M. Lippincott	212 West 114th street
	E. G. Love	122 Bowery
	Robt. O. Luqueer	31 Nassau street
	W. N. McIlravy	100 William street
	Emerson McMillin	40 Wall street
	Converse D. Marsh	136 Liberty street
	J. Alex. Mayers	32 Pine street
	Alten S. Miller	4 Irving Place
	William N. Milsted	11th avenue and 47th st.
	Albion L. Page	180 Fulton street
	Geo. Q. Palmer	742 East 12th street
	James D. Perkins	228 Produce Exchange
	Daniel J. Prendergast	33 Nassau street
	Geo. G. Ramsdell	395 Broadway
	William W. Randolph	31 Nassau street
	A. F. Reichelt	350 Alexander avenue
	Eugene Rosenquest	Westchester
	Thomas F. Rowland	329 Madison avenue
	Henry C. Scheel	11 Broadway, Room 921
	F. Schniewind	277 Broadway
	F. Seaverns	228 Produce Exchange
	Robert A. C. Smith	100 Broadway
	Chas. F. Terhune	1133 Broadway
	Lucien P. F. Tull	340 Third avenue
	George H. Warner	1131 Broadway
	Wesley Webber	6 Wall street
	Adam Weber	633 East 15th street

New York	Oscar B. Weber	633 East 15th street
	A. F. Wehner	245 Broadway
	F. K. Wells	356 Fourth avenue
	William Henry White	32 Pine street
	Charles R. Whittier	45 Broadway
	H B. Wilson	40 Wall street
	Edwin E. Witherby	40 Wall street
	George E. Woods	4 Irving Place
	Oscar F. Zollikoffer	49 West 54th street
Nyack	A. M. Voorhis	Broadway
Ogdensburg	J. H. Findlay	17 Franklin street
Penn Yan	Rudolph Riege	300 Liberty street
Port Chester	Wm. C. Anderson	101 North Main street
	Wm. A. Mills.	
Port Jervis	John Collins	1 Mt. William street
Poughkeepsie	James M. Hadden.	
Ravenswood, L. I.	City, W. Cullen Morris.	
Rochester	John F. Bush	1118 North St. Paul street
	G. W. Graves	32 South avenue
Sag Harbor	S. E. Linton, Jr.	
Stapleton	Thos. O. Horton	264 Bay street
Syracuse	T. Littlehales	715 East Genesee street
	Austin C. Wood	216 North West street
Tarrytown	Augustus Konrad,	40 North Washington street
Utica	Edward A. Pinkney	217 Genesee street
Watertown	Henry C. Whitney	Arsenal street
Yonkers	G. W. Curran	115 Hawthorne avenue
	B. W. Stilwell	67 N. Broadway

NORTH CAROLINA.

Brevard	Arthur E. Boardman.	
Charlotte	M. Nisbet Latta.	
Raleigh	M. Bowes.	
Wilmington	John W. Reilly	116 South Sixth street
Winston-Salem	R. V. Howes.	

OHIO.

Bucyrus	J. W. Gwynn.	
Canton	L. W. Wells	137 East 5th street

Cincinnati	Andrew Hickenlooper	4th and Plum streets
	William A. Miller	2817 Eastern avenue
	James E. Stacey	239 Mill street
Cleveland	Franklyn L. Alcott.	
	Malcolm S. Greenough	356 Superior street
	Howard E. Mann.	
	Virgil G. Marani	356 Superior street
	J. J. Potter.	
	H. J. Trenkamp.	
	Daniel R. Warmington	410 Pearl street
	George H. Warmington	410 Pearl street
	John F. Wilcox	1310 New England Building
Columbus	Ernest E. Eysenbach.	
Dayton	W. P. Callahan	901 East Third street
	Robert R. Dickey	Main and Second streets
	Henry C. Graves	Main and Second streets
	Geo. Light	205 East First street
	Joseph Light	203 East First street
	John K. McIntire	116 North Main street
Delaware	T. C. Jones.	
Fostoria	William D. Marks.	
Lorain	C. A. Schwarm	521 Broadway
Marietta	Beman G. Dawes.	
Piqua	Stanhope Boal.	
Steubenville	J. Chas. Ross.	
Toledo	C. A. Byers.	
	Chas. R. Faben, Jr	327 South Erie street
	Fred. R. Persons	317 St. Clair street
Warren	George H. Tayler	209 Main street
Zanesville	Eugene Printz	North Sixth street

OREGON.

Portland	Charles F. Adams	Fifth and Yawhill streets
Salem	J. B. T. Tuthill	4 Chemeketa street

PENNSYLVANIA.

Allegheny	H. A. Carpenter.	
	Willard B. Osborne.	
	John Young	603 West Diamond street

Allentown	Arthur F. Bigelow	540 Hamilton street
Altoona	George H. Harper	2526 Broad avenue
	John Lloyd	First National Bank
Ardmore	W. E. Barrett	13 Simpson Road
Catasauqua	Jas. R. Floyd, Jr.	
Chester	John M. Callanan	517 Market street
Darby	John D. Shattuck	889 Main street
Easton	Edwin G. Holzer.	
	William H. Ward	228 Front street
Erie	F. H. Payne.	
Harrisburg	L. S. Williams	1204 North Second street
Hanover	R. Hayes Dutton.	
Honesdale	Henry Z. Russell.	
Johnstown	Anderson H. Walters	405 Main street
Lancaster	J. H. Baumgardner	129 North Queen street
Norristown	Herbert H. Ganser.	
Philadelphia	Harry C. Adams	224 South Third street
	J. Edward Addicks,	1212 Real Estate Trust Building
	J. C. Andrews	19th st. and Allegheny avenue
	F. M. Arthur	1706 North Broad street
	H. S. Battin	19th street and Allegheny ave.
	A. B. Beadle	1405 Arch street
	Samuel T. Bodine	Broad and Arch streets
	William H. Bower,	Gray's Ferry Road and 29th street
	Cyrus Borgner	23rd street above Race
	E. L. Brundrett	1401 Arch street
	James Buckman	8th and Green streets
	Henry R. Cartwright,	N. W. cor. 22nd & Arch streets
	William Cartwright	3413 Baring street
	Walton Clark	Broad and Arch streets
	H. W. Coleman	1051 Drexel Building
	D. J. Collins	1403 Arch street
	J. A. P. Crisfield	Broad and Arch streets
	Samuel Philip Curtis	222 South Third street
	E. J. Donahue	Broad and Arch streets
	Edward H. Earnshaw	22nd and Filbert streets
	George W. Elkins	423 Walnut street

Philadelphia ...... William P. Fodell............50 Laurel street
Walton Forstall......Broad and Arch streets
John Fowler................39 Laurel street
William H. Gartley.........1401 Arch street
Thomas L. George....Broad and Arch streets
P. H. Gibbons............2817 Morris street
W. W. Gibbs............850 Drexel Building
John Gribbel...............1513 Race street
Carl M. Guenther....12th and Brown streets
Jansen Haines.......Broad and Arch streets
J. A. Harris ....1513 Race street
William E. Helme.........1339 Cherry street
William H. Hopper,
137 West Washington lane, Germantown
Lewis Lillie...........Broad and Arch streets
Alex. J. McCleary....22nd and Filbert streets
Edmund H. McCullough, 224 South 3rd street
William MacDonald............Point Breeze
John McIlhenny..........1339 Cherry street
John D. McIlhenny.......1339 Cherry street
Martin Molony......37th and Market streets
Henry G. Morris.....408 Philadelphia Bourse
Carroll B. Nichols....224 South Third street
J. O. Nicolls......Real Estate Trust Building
Rollin Norris.........Broad and Arch streets
Carter H. Page, Jr....Broad and Arch streets
William K. Park.....22nd and Filbert streets
Joshua Ash Pearson..Broad and Arch streets
Clarence V. Roberts...3rd and Mifflin streets
George J. Roberts....Broad and Arch streets
E. H. Rodgers......942-944 Drexel Building
William L. Rowland....4800 Chester avenue
William J. Serrill.....Broad and Arch streets
F. H. Shelton.........112 North Broad street
Alfred D. Silliman....Broad and Arch streets
John W. Smith..............60 Laurel street
William H. Smith......1931 South 9th street
B. H. Spangenberg, Town Hall, Germantown
Henry Steck...631 Chestnut street, Room 12
J. W. Stirzel.....Richmond and Tioga streets

Philadelphia ...... Morris W. Stroud ..... 222 South Third street
D. L. Summey, N. W. cor. Broad & Arch sts.
Paul Thompson, N. W. cor. Broad & Arch sts.
Wm. Nichols Tolman ... 3067 E. Thompson st.
Benj. S. Walters .... 2051 Walnut street
John S. Welch,
N. W. cor. Broad and Arch sts.
Henry Wharton .... 224 South Third street
John S. Wilbraham ... 2518 Frankford avenue
John W. Wilbraham .. 2518 Frankford avenue
Edward R. Wood, Jr. .. 245 South 17th street
Stuart Wood .... 400 Chestnut street
Walter Wood .... 400 Chestnut street
Phœnixville .... David Buck .... 224 Bridge street
Pittsburg .... Geo. F. Duck.
E. H. Henderson .... 335 Fifth avenue
Robert Young .... 435 Sixth avenue
Reading .... John H. Keppelman ..... 20 North 5th street
Royersford ...... John H. Mansur.
Joshua J. Nix .... 353 Church street
South Bethlehem .. Henry W. Benner.
Williamsport ...... Q. S. Backus.
James W. Lane ..... 1046 West Fourth street
Wyncote .... Lewis R. Dutton.
York .... Grier Hersh.
Jacob L. Kuehn .. 33 East Philadelphia street
Fred. R. Smart, Jr. ...... 25 W. Market street

RHODE ISLAND.

Newport .... A. K. Quinn .... 181 Thames street
Providence .... Charles W. Blodget .... 20 Market square
A. B. Slater .... 251 Rhodes street
Riverside .... James H. Armington.

SOUTH CAROLINA.

Charleston .... Thomas Turner .... 224 Calhoun street
Columbia .... John M. Daniels .... 1330 Main street
Spartanburg ...... J. C. Norcross.

SOUTH DAKOTA.

Sioux Falls	W. H. McKenzie.	

TENNESSEE.

Chattanooga	James Forbes	619 Cherry street
	Robert Bruce Steward.	
Memphis	J. H. Cardall	Main and Mill streets

TEXAS.

Galveston	John Gimper.	
San Antonio	E. H. Jenkins	403 East Houston street

UTAH.

Salt Lake City	John Kempf, Jr	769 Main street

VERMONT.

Burlington	Robert B. Taber.	
St. Albans	C. W. Butterworth.	

VIRGINIA.

Lynchburg	Richard D. Apperson.	
Newport News	William S. Bowen	139 28th street
Norfolk	Frederic Egner.	
	Henry L. Rice.	
Petersburg	William H. Baxter	201 Sycamore street
Portsmouth	Henry H. White.	
Richmond	W. P. Knowles	23 East Canal street
Roanoke	John C. Rawn	Church ave. and Henry st.

WASHINGTON.

Seattle	C. Russell Collins	Globe Building
Spokane Falls	W. A. Aldrich	E. 301 Boone avenue
Tacoma	Wm. W. Seymour.	
Walla Walla	C. E. Burrows.	
Whatcom	W. S. Wharton	301 Holly street

WISCONSIN.

Appleton	George McMillan	761 Lawrence street
Janesville	Ira F. Wortendyke.	
Milwaukee	Frederick Bredel	118 Farwell avenue
	R. B. Brown	182 Wisconsin street
	Julius Buss.	
	Edward G. Cowdery	182 Wisconsin street
	Sheldon J. Glass	182 Wisconsin street
Waukesha	H. M. Buck.	

AUSTRIA.

Vienna	Carl Ritter Auer von Welsbach,	IV. Wiedner Hauptstrasse No. 69.

GERMANY.

Dessau	W. von Oechelhaeuser.	
Karlsruhe	Dr. Hans Bunte.	

ENGLAND.

Liverpool	William King	Duke street
London	Arthur G. Glasgow	38 Victoria street, S. W.
	George T. Livesey	Old Kent Road
	J. A. Norcross	38 Victoria street, S. W.
	Horace G. Taylor, M. E,	38 Victoria street, S. W.
	John T. Westcott,	19 Abingdon street, Westminster, S. W.
	Corbet Woodall,	Palace Chambers, Westminster

FRANCE.

Lyon (Rhone)	Th. Vautier	46 rue Centrale

JAPAN.

Tokio	Suyekichi Hiramatsu.	

NOVA SCOTIA.

Halifax	Robert Baxter.	

ONTARIO, CANADA.

Brantford	Wm. M. Cathels	48 George street
Brockville	C. T. Wilkinson.	
Hamilton	Fred. W. Gates	17 Herkimer street
	Edmund Cathels.	
London	Charles Forbes.	
Ottawa	John R. Coates	23 Sparks street
	Thos. Dunderdale	190 Ottawa street
Toronto	L. L. Merrifield	157 Dowling avenue
	William H. Pearson	19 Toronto street
	William H. Pearson, Jr.	95 Isabella street

QUEBEC, CANADA.

Quebec	David H. Geggie	2 Place d'Orleans

ADDRESS UNKNOWN.

Ferdinand McKeige.

New England	87
Middle States	300
District of Columbia and South, east of the Mississippi River	37
North of Ohio River, and east of the Mississippi River	95
West of the Mississippi River	64
Austria	1
Canada and Nova Scotia	12
England	7
France	1
Germany	2
Japan	1
Address Unknown	1
Total	608

MEMBERS DECEASED

George W. Parsons	Rochester, N. Y.	——	—,	1875
Cornelius L. Everett	New York, N. Y.	Oct.	—,	1875
G. T. Sutton	Peekskill, N. Y.	Apr.	—,	1876
Charles Collier	Selma, Ala	May	—,	1876
W. H. Perry	Bangor, Me	May	—,	1877
William B. Clelland	Vicksburg, Miss	Oct.	15,	1878
Gen. Laz Noble	Vincennes, Ind	Oct.	18,	1879
George Buist	Halifax, N. S.	Nov.	2,	1879
Oliver G. Steele	Buffalo, N. Y.	Dec.	10,	1879
George W. Edge	Jersey City, N. J	Jan.	1,	1880
Kerr Murray	Ft. Wayne, Ind	May	6,	1880
John C. Buxton	Springfield, O	July	20,	1880
George Dwight	Springfield, Mass	Feb.	1,	1881
Elmer W. Clark, Jr	Philadelphia, Pa	Mar.	5,	1881
Eli Butler	Meriden, Conn	May	24,	1881
Henry Budd	Philadelphia, Pa	May	28,	1881
Henry Cartwright	Philadelphia, Pa	June	30,	1881
Edwin Keith	Taunton, Mass	Apr.	30,	1882
G. Warren Dresser (Honorary)	New York, N. Y	May	27,	1883
M. H. Jones	Easton, Pa	June	1,	1883
W. H. Price	Cleveland, O	June	8,	1883
James D. Merriman	Vera Cruz, Mexico	June	10,	1883
A. W. Richardson	North Adams, Mass.	Sept.	4,	1883
Miles W. Caughey	Erie, Pa	Sept.	20,	1883
Wilmer G. Cartwright	Hoboken, N. J	Feb.	23,	1884
Philips Peebles	Quebec, Can	May	15,	1884
Ignaz Herzog	New York, N. Y	Oct.	23,	1884
Thomas Butterworth	Rockford, Ill	Apr.	5,	1885
George Cornell	Youngstown, O	Apr.	22,	1885
Francis Thompson	Charlestown, Mass	Aug.	30,	1885
James D. Brewer	Springfield, Mass	Feb.	7,	1886
Emile J. Durand (Honorary)	Paris, France	Feb.	—,	1886
John Anderson	Ironton, O	June	25,	1886
James H. Walker, Sr	Tonawanda, N. Y.	Mar.	1,	1887
T. F. White	Houston, Texas	Feb.	28,	1888
John C. Pratt	Jamaica Plain, Mass	June	7,	1888
William Helme	Atlanta, Ga	June	12,	1888
Joseph H. Collins	Philadelphia, Pa	June	26,	1888
John M. Murphy	Baltimore, Md	Aug.	25,	1888
John McDougall	Hornellsville, N. Y	Nov.	2,	1888
C. H. Nash	St. Louis, Mo	Nov.	9,	1888

John Cartwright	Poughkeepsie, N. Y	Dec.	19,	1888
C. F. Maurice	Sing Sing, N. Y	Dec.	24,	1888
Robert P. Spice (Honorary)	London, England	May	11,	1889
Edward J. King	Jacksonville, Ill	Oct.	28,	1889
Oliver E. Cushing	Lowell, Mass	June	17,	1890
THEOBALD FORSTALL	Chicago, Ill	Jan.	19,	1890
William Parrish	Seneca Falls, N. Y	Jan.	19,	1890
Walter B. Houston	Rahway, N. J	Apr.	3,	1890
James Henri Rollins	Worcester, Mass	June	19,	1890
GEN. CHAS. ROOME (Honorary)	New York, N. Y	June	28,	1890
B. F. Sherman	New York, N. Y.	Oct.	31,	1890
Nathaniel Tufts	Boston, Mass	Nov.	9,	1890
Geo. W. Kraft	Philadelphia, Pa	Dec.	22,	1890
William Mooney	New York, N. Y	Jan.	21,	1891
William H. Down	New York, N. Y	Feb.	15,	1891
I. Linton	Ravenna, O	Mar.	—,	1891
J. M. Sterling	Monroe, Mich	May	18,	1891
E. M. Russell	St. Louis, Mo	May	28,	1891
Samuel Prichitt	Nashville, Tenn.	Sept.	21,	1891
John Andrew	Chelsea, Mass	Feb.	10,	1892
Geo. Shepard Page	New York, N. Y	Mar.	26,	1892
Charles Nettleton	New York, N. Y	May	5,	1892
Alfred M. Norton	Nashua, N. H	July	13,	1892
George A. McIlhenny	Washington, D. C	Oct.	16,	1892
John J. Griffin	Philadelphia, Pa	Oct.	22,	1892
Austin M. Copp	Boston, Mass	Nov.	1,	1892
Fred. H. Odiorne	Boston, Mass	Jan.	3,	1893
Frank H. Dyer	Salt Lake City, Utah	Mar.	—,	1893
Matthew Cartwright	Rochester, N. Y	Apr.	25,	1893
Henry C. Hordley	Cumberland, Md	May	5,	1893
Edward Jones	South Boston, Mass	Aug.	1,	1893
Thomas C. Hopper	Philadelphia, Pa	Feb.	23,	1894
Frederick A. Sabbaton	Troy, N. Y	Apr.	14,	1894
John H. Knowles	Richmond, Va	May	5,	1894
Paul S. Merrifield	New York, N. Y	May	12,	1894
Samuel G. Stiness	Pawtucket, R. I	Nov.	5,	1894
Thomas D. Gilbert	Grand Rapids, Mich	Nov.	18,	1894
Geo. Henry Wells	Nashville, Tenn	Nov.	22,	1894
Thomas C. Cornell	Yonkers, N. Y	Dec.	29,	1894
Sylvester S. Townsend	New York, N. Y	Jan.	14,	1895
James McCutcheon	Pittsburg, Pa	Mar.	4,	1895
Oscar Zollikoffer	New York, N. Y.	Apr.	7,	1895
A. P. Collins	New Britain, Conn	Apr.	21,	1895
Wm. C. Adams	Richmond, Va.	May	19,	1895
C. A. Bennett, Jr	Freehold, N. J.	July	24,	1895
Wilbur H. Townsend	New York, N. Y	Feb.	26,	1896
Jos. R. Thomas	New York, N. Y.	Nov.	28,	1896
Jos. D. Weeks	Pittsburg, Pa.	Dec.	26,	1896

John W. Newell	New Brunswick, N. J	Jan.	5,	1897
Fred W. Norton	Nashua, N. H	Oct.	2,	1897
W. L. Proctor	Ogdensburg, N. Y	Nov.	17,	1897
James F. Rogers	Jamaica Plain, Mass	Dec.	18,	1897
George D. Cabot	Lawrence, Mass	Jan.	18,	1898
John Tracey	Poughkeepsie, N. Y	Mar.	19,	1898
Clefford L. Slade	Portchester, N. Y	May	18,	1898
Wm. Gardner	Pittsburg, Pa	Aug.	5,	1898
Geo. S. Hookey	Augusta, Ga	Oct.	18,	1898
Wm. W. Greenough (Honorary)	Boston, Mass	June	17,	1899
Jerome Croul	Detroit, Mich	Sept.	26,	1899
Geo. W. Starr	Wallingford, Conn	Dec.	25,	1899
D. E. Knight	Marysville, Cal	Jan.	5,	1900
Jas. Gardner, Jr	Pittsburg, Pa	Jan.	16,	1900
James M. Starr	Richmond, Ind	June	17,	1900
Milton J. Payne	Kansas City, Mo	July	17,	1900
William J. Fay	Anaheim, Cal	Aug.	4,	1900
W. G. Chandler	Harrisburg, Pa	Aug.	14,	1900
George Treadway Thompson	Denver, Colo	Oct.	1,	1900
W. G. Abel	Atlanta, Ga	Dec.	21,	1900
A. C. Gandey	Lambertville, N. J	Dec.	30,	1900
Harold Humphreys	New York, N. Y	Feb.	12,	1901
David W. Crafts	Northampton, Mass.	Mar.	12,	1901
Charles C. Fry	Lynn, Mass	Mar.	21,	1901
William Stacey	Cincinnati, Ohio	June	17,	1901
James Slade	Yonkers, N. Y	June	18,	1901
Geo. B. Neal	Charlestown, Mass	July	7,	1901
Wm. E. Barrows	Philadelphia, Pa	July	30,	1901
Wm. W. Goodwin	Philadelphia, Pa	Oct.	6,	1901

Number deceased while on Roll . . . 118

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